HP 4951C
PROTOCOL ANALYZER
Operating Manual

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Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products. For any assistance, contact your nearest Hewlett-Packard Sales and Service Office.

Safety Class

The HP 4951C is a Safety Class I instrument, provided with a protective earth terminal.

Safety Summary

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of this instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

GROUND THE INSTRUMENT

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet international Electrotechnical Commission (EC) safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjust unless another person, capable of rendering first aid and resuscitation, is present.

USE CAUTION WHEN EXPOSING OR HANDLING THE CRT

Breakage of the Cathode-ray Tube (CRT) causes a high-velocity scattering of glass fragments (implosion). To prevent CRT implosion, avoid rough handling or jarring of the instrument. Handling of the CRT shall be done only by qualified maintenance personnel using approved safety mask and gloves.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification of the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

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Printing History

Each new edition of this manual incorporates all material updated since the previous edition. Manual change sheets are issued between editions, allowing you to correct or insert information in the current edition.

The part number on the back cover changes only when each new edition is published. Minor corrections or additions may be made as the manual is reprinted between editions

First Edition.....May 1987

1

Introducing the HP 4951C Protocol Analyzer

The HP 4951C is a portable, data communications protocol analyzer that contains the essential features required to install, maintain and design data networks up to 19.2 kbps. Here are some unique features:

Auto Configure. Automatically determine line parameters and begin monitoring.

Post-Processing. Use captured data repeatedly for new measurements.

Softkey guided measurements. Simplifies setup and programming.

Full ASCII keyboard. Enter all control or hex characters.

Nonvolatile memory. 32 Kbytes for storing data line information. Additional 8 Kbytes for storing menus and programs.

Five display formats. DTE Only, DCE Only, Two Line (DTE and DCE), Data & State (DTE and DCE with lead transitions), Frame & Packet (decoding of level 2 and 3).

Remote. Transfer data, setups, monitor and simulate menus, timers and counters over a data link.

BERT. Measure bit error rates, block errors, and percent error free seconds.

Disc Storage. Mass storage of data, setups, programs, and measurements.

Printer Output. Print data, monitor and simulate programs, setup and test results. Access printer from rear panel RS-232 port or interface pod.

External Video Driver. Display real time data, buffer data, menus and programs on external monitor using rear RS-170 port.

How To Use This Manual

This manual is in two parts. **Part I** tells how to operate the HP 4951C: Use this part on the first day. **Part II** describes the menus in detail; Use this part after you are familiar with Part 1.

PART I GETTING STARTED

Chapter 1 **Learning the Controls --** Describes the HP 4951C controls including power up and installation, front panel controls, the top level menu, and rear panel features.

Chapter 2 **The Three Instrument Functions --** Shows you how to perform the three HP 4951C functions: **Monitoring**, **Simulation**, and **B**it **E**rror **R**ate **T**ests - (BERT tests).

Chapter 3 **A Self Demonstration --** You learn by actual operation.

PART II THE MENUS

Chapters 4 through 12 explain each menu in detail by following the order of the **Top Level** softkeys. The Top Level Menu (page 1-8) accesses all instrument functions. To access the Top Level Menu at any time, press EXIT.

MANUAL CONVENTIONS

Softkeys are enclosed by <> . **Hardkeys** are **capitalized**.

Before You Get Started

Initial Inspection. Inspect the analyzer and accessories for any physical damage sustained in transit. Ensure that you have received all the items that should accompany the analyzer (Refer to Accessories Supplied in Appendix C). If accessories are missing or if the unit is received in a damaged condition, notify the nearest HP Sales and Support Office and file a claim with the carrier.

Line Voltage Selection. Before connecting any ac power, be sure the line voltage for your area is between 100 - 240 Vac +-10% at 48 to 66 Hz. There is **no** line voltage selection. To change the fuse, refer to Appendix E.

Grounding Requirements. The HP 4951C is equipped with a three-conductor power cable which, when connected to an appropriate power outlet, grounds the analyzer. To preserve this protection, do not operate the analyzer from a line power outlet that has no ground protection.

Power Cord. The power cord packaged with each analyzer depends on its destination. Appendix E has a chart of power cord plugs matched to different areas. If the analyzer has the wrong power cord for the area, contact your HP Sales and Support Office.

Shipment. Refer to Appendix E for packaging information. If your analyzer is being returned for service, contact the nearest HP Field Repair Center or Sales and Support office for complete shipping instructions.

Power Up and Installation

TURNING THE HP 4951C ON

WARNING

Do not plug in the instrument until you are sure the line voltage is correct: 100/240 VAC +-10% at 48/66 Hz.

Connect the ac power cord to the HP 4951C power cord connector and then to the ac line connector. Set the power switch on the rear panel to the on (1) position.

Self Tests. If your instrument displays the Top Level Menu after power-on, you can be confident that internal circuits (except disc drive and interface pod) are working correctly. Refer to Appendix E for complete information on performance verification procedures.

CONNECTING THE POD

CAUTION

Always turn the instrument off before connecting or disconnecting the pod.

Connect the interface pod cable to the interface pod connector on the rear panel (See Figure 1-3). Tighten the connector screws so that the cable will not pull off during operation.

TURNING THE HP 4951C OFF

CAUTION

Always go to the top level menu before turning the instrument off.

Set the power switch on the rear panel to the off (0) position.

The HP 4951C contains a battery for maintaining current data and menu setups after turn off. However, if you turn off the analyzer at certain times (e.g., during a run)

data or setups may be destroyed. A message to this effect then appears, and the analyzer resets itself automatically. To ensure that menus and setups are saved after turn off, always go to the Top Level Menu before turning the analyzer off. If you do not wish to save the menus and data, press <Reset> in the Top Level Menu to clear the memory and return to default settings. See Chapter 12.

HOOKUP

Hookup directions for monitoring, simulating and BERT are given in Chapter 2. BERT hookup is also shown in Chapter 9.

Front Panel Controls

KEYBOARD

The HP 4951C has a full ASCII keyboard. The following keys have special functions (See Figure 1-1):

SOFTKEYS The six function keys directly under the display. The label of each key, shown at the bottom of the display, changes for each menu and field. Except when entering keyboard characters, use the softkeys to enter all parameter selections.

CURSOR KEYS The four arrow keys which move the cursor.

EXIT Accesses the Top Level Menu. During a run, EXIT is a halt key. In some menus like BERT and Mass Store, you must press EXIT twice.

MORE Accesses additional softkeys whenever more are available.

SHIFT Selects lower-case characters when pressed with another key.

CNTL Selects a control character (upper label on keycaps) when pressed with another key.

RTN Moves the cursor to the next lower field (same as cursor down).

DISPLAY The 5 inch display shows 16 lines of 32 characters. Softkey labels occupy the bottom two lines.

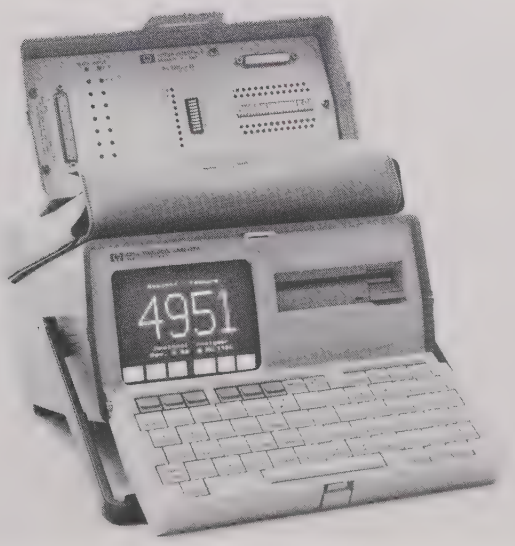
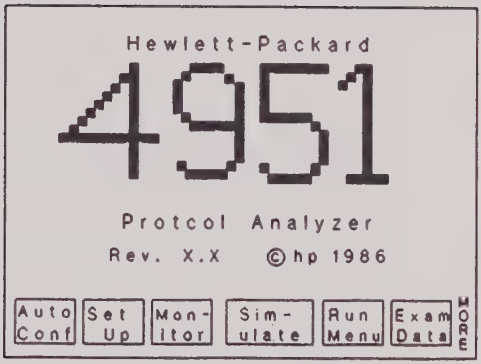


Figure 1-1. Front Panel Controls

The Top Level Menu

The Top Level Menu (Figure 1-2) accesses all instrument functions. The Top Level Menu is displayed whenever the instrument is turned on. Press EXIT to access the Top Level Menu. Press MORE to see the other Top Level softkeys. Top Level softkeys are described below.

Auto Conf	Automatically configure to line parameters (when monitoring on-line).
Set Up	Manually configure to line parameters.
Monitor	Select monitoring measurements and triggers to analyze data.
Simulate	Select simulation measurements, triggers and send data.
Run Menu	Run monitor tests, simulation tests, or BERT tests.
Examine Data	Display data stored in the buffer or on disc.
Bert Menu	Configure Bit Error Rate Test parameters.
Remote	Transmit and receive menus and data to another HP 4951, or to a 4955A or a 4953A.
Mass Store	Control disc functions.
Reset	Reset all menus to their default conditions and clear the buffer.
Self Test	Perform self-test procedures.




```
    -->  Auto-     Setup     Monitor     Simulate     Run       Examine--->--
    |    Config                                      Menu      Data        |
[MORE]                                                          [MORE]
    |    BERT       Remote    Mass                   Reset     Self        |
    --<  Menu                 Store                            Test -----<--
```

Figure 1-2. The Top Level Menu

Rear Panel Features

Here is a description of the HP 4951C rear panel features.

LINE SWITCH — Press the side of the line switch to turn the instrument on. Press the other side of the line switch to turn the instrument off.

REMOTE/PRINTER — Use this connector to connect the HP 4951C in Remote Mode either as a controller or a slave unit. Refer to Chapter 10.

Also use this connector to connect an ASCII printer through which you can print display data. Refer to Chapter 13.

INTERFACE POD — The interface pods are connected to this connector.

EXT VIDEO — This connector lets you connect an external video monitor to the HP 4951C. The video output follows RS-170 conventions. Refer to Appendix F.

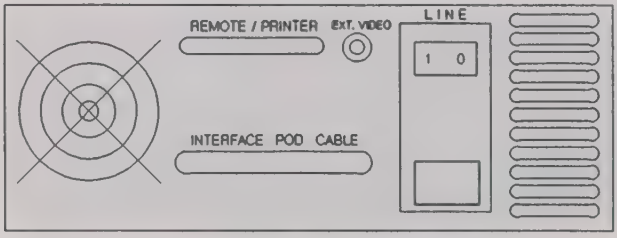


Figure 1-3. Rear Panel Features

2

The Three Instrument Functions

Introduction

This chapter describes the three basic functions of the instrument: **Monitoring**, **Simulating**, and **Bit Error Rate Tests**. For more information on these topics, or on any Top Level softkey, go to the chapter by that title.

After looking over this chapter, you may want to go right on to Chapter 3, which leads you through monitoring and simulating exercises with the instrument.

Things To Remember

The Top Level Menu accesses all other menus. EXIT will access the Top Level Menu at any time. In some menus you must press EXIT twice.

EXIT acts like a halt key during program execution. EXIT stops execution and accesses the Top Level softkeys.

Press MORE to see any additional softkeys in any menu. A small vertical "more" at the lower right of the display prompts you whenever there is another softkey set in any menu.

Always go to the Top Level Menu before turning the analyzer off. This ensures that setups, data, and programs are saved in non-volatile memory.

Always turn the analyzer off before connecting and disconnecting the pod.

THE THREE INSTRUMENT FUNCTIONS

I. Monitoring

On-Line. Using Auto Configure or the correct manual setup, you can bridge into most data lines and begin observing the activity.

From Buffer. After having monitored the line for a few seconds, you will have captured data in the buffer memory. Once you have data in the buffer, you can repeatedly run any monitoring measurements, just as if you were monitoring on-line. You can also load the buffer from disc. This "Post-processing" lets you try many different measurements on the same data.

II. Simulation

You can substitute the HP 4951C for any DTE (Data Terminal Equipment) or DCE (Data Communications Equipment) on the line, performing measurements while you transmit and receive strings of data characters. The HP 4951C continuously monitors both channels while monitoring on-line or simulating.

III. Bit Error Rate Tests (BERT)

This function lets you determine the data link quality. You can find bit and block errors, error seconds, and percent error free seconds.

I. Monitoring

The HP 4951C is a "window" through which you can observe the activity on a data link. The HP 4951C lets you trigger on events and make measurements either on-line, or from the buffer memory. By monitoring from buffer memory, you can repeatedly post-process/review data after a run. This can be especially advantageous for "glitch" or "after hours" type problems that do not occur "on demand".

SUMMARY OF MONITORING STEPS (Described on the following pages)

1.	Hookup	Bridge the HP 4951C into line to be monitored.
2.	Setup	Using either Auto Configure or the Setup Menus, configure the HP 4951C to the line.
3.	Triggering	Set up any triggers or test conditions using the Monitor Menu. You need make no entries in the Monitor Menu. If you don't use the Monitor Menu, go directly to step 4.
4.	Running	Begin monitoring by accessing the Run Menu. The HP 4951C begins non-selectively displaying line data as soon as you enter the Run Mode.

STEP 1: HOOKUP

Bridge the HP 4951C into the line, using the correct pod (e.g., RS-232C/V.24 ,V.35, or RS-449) and cables, as shown below. If you already have data in the buffer from a previous run or via disc, you can monitor from buffer; and no pod is necessary. Always turn off the analyzer before connecting or disconnecting the interface pod.

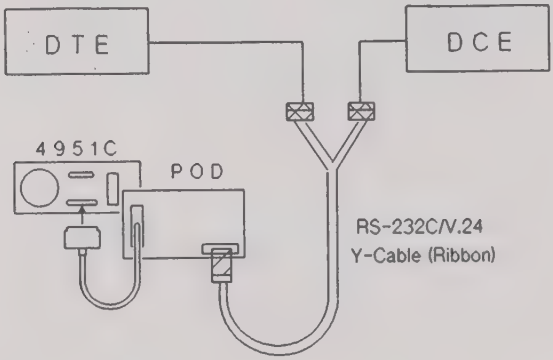


Figure 2-1. Hookup for Line Monitoring

STEP 2: SETUP

Prior to monitoring, you must configure the HP 4951C for the line. You should do this first, because setup selections affect the ability to capture meaningful data from the line. Also, setup selections determine the available choices in other menus.

You can use either Auto Configure or the Setup Menus. Using Auto Configure, the HP 4951C automatically configures to the line and begins monitoring. You may also use the Setup Menus and then go to the Run Menu.

Using Auto Configure for Setup

Press <Auto Configure>, the HP 4951C identifies line parameters and begins monitoring.

```
At slow data rates, often times there is not enough data present for the
HP 4951C to identify what's going on.  Nor to allow the instrument to
"lock onto" the setup for the line being monitored.
```

Two things can be done:

1: Have a large file sent on the line from the host device.

2: Hold the return key down on a terminal on the line being monitored to cause more data to be sent over the line.

To change the display format, or to modify any setup parameters, halt the run by pressing EXIT, and go to the Setup Menus (See Chapter 5).

In some nonstandard protocols, the HP 4951C may not be able to identify all the parameters. In that case, halt the run and modify the setup in the Setup Menus.

Using the Setup Menus for Setup

To manually configure the HP 4951C, or to modify Auto Configure results, press <Setup> on the Top Level Menu.

1. Select the appropriate protocol.

2. Change any parameter by moving the cursor to that field and pressing the desired softkey. See Chapter 5 for more details.

3. To begin monitoring, press EXIT and then <Run Menu>. Then press <Monitor Line>. The HP 4951C begins filling the buffer and displaying data.

What to Do When the Protocol is Nonstandard

If you have trouble configuring the analyzer because of a nonstandard protocol, or because of a defective line, use the following procedure.

1. Use Auto Configure to give you a starting point. See Chapter 4 for limitations.

2. Change the data code, or other parameters in the appropriate Setup Menu. See Chapter 5 if you need more details.

3. If some of the line data is still not meaningful, use the Char Async, Sync Setup Menu, as described in Chapters 5 and 8.

STEP 3: SETTING UP TRIGGERS

Optional Entry

You need make no entries in the Monitor Menu. You can go right to the Run Menu and begin monitoring.

Measurements in the Monitor Menu

If you just want to look at the data, you can go right to the Run Menu and begin monitoring. However, if you want to perform tests and analyze the data, the Monitor Menu gives you that capability. It might help to think of the Menu choices as a "logical programming language" for the HP 4951C which lets you control the manner in which the HP 4951C monitors the data.

Here's a summary of what the Monitor Menu can do:

Triggering	Define triggers with the <When> statement, enabling you to "look for" up to 63 events simultaneously. The HP 4951C will branch to another action upon finding a trigger.
Timing	Five timers measure intervals between triggers with 1 millisecond resolution.
Counting	The HP 4951Cs' five counters can each count up to 9999 events.
Conditional Actions	The <If> statement performs actions conditionally, depending on the status of a counter or a lead at the time of the last trigger.

To access the Monitor Menu, press <Monitor> in the Top Level Menu. Then utilize the softkeys to modify or "build" a custom menu.

STEP 4: RUNNING THE TEST

In Auto Configure, the HP 4951C automatically goes into the run mode and begins monitoring. Once Auto Configure has established the setup you can monitor the line or buffer on subsequent trials from the Run Menu.

If you are not using Auto Configure, press <Run Menu> on the Top Level Menu. To monitor on-line data, press <Monitor Line>. If data is already in the buffer from a previous run or from disc, press <Monitor Buffer> to do post processing. Monitoring on-line and monitoring from buffer are essentially the same processes.

When monitoring starts,

1. All counters and timers are reset to zero.
2. Any programs in the Monitor Menu begin executing.
3. Buffer data is displayed starting at data block 1.

STEP 5: HALTING THE RUN

Press EXIT to stop the test. The most recent data is displayed. You can freeze the display without halting the test by pressing <Stop Display>.

Changing Display Formats

To choose a different display format, halt the run and change the display format field in the Setup Menu. In HDLC, SDLC, and X.25, five formats are available: DTE, DCE, Two-Line, Data & State, and Frame & Packet. In the BSC and Char Async/Sync Menus, the Frame and Packet format is not available. See Chapters 7, and 8.

II. Simulating

The HP 4951C can take the place of either a **DTE** (**D**ata **T**erminal **E**quipment) or **DCE** (**D**ata **C**ircuit-Terminating **E**quipment), by supplying clocks, data, and error checks in the selected data code and protocol.

SUMMARY OF SIMULATING STEPS (Described on the following pages)

1. Hookup — Substitute the HP 4951C for either the DTE or DCE.

2. Setup — Using either Auto Configure or the Setup Menus, configure the HP 4951C to the line.

3. Data, Triggers — Using the Simulate Menu:

    a. Select the device to be simulated: DTE or DCE.

    b. Configure the interface, using the <Set Lead> softkey.

    c. Transmit the desired characters, using the <Send> softkey.

    d. Use triggers, timers, etc., as in the monitor menu.

4. Running — To begin simulating enter the Run Menu. In synchronous setups, the ETC clock is automatically provided when simulating a DTE. The TC and RC clocks are automatically provided when simulating a DCE.

STEP 1: HOOKUP

Disconnect the line and substitute the HP 4951C for the device (DTE or DCE) being simulated.

NOTE

Always turn off the analyzer before connecting or disconnecting the interface pod.

Remember that non-volatile memory saves setups, menus and data while the HP 4951C is turned off. Be sure to use the correct pod (RS-232C/V.24,V.35, or RS-449) and cables as shown below.

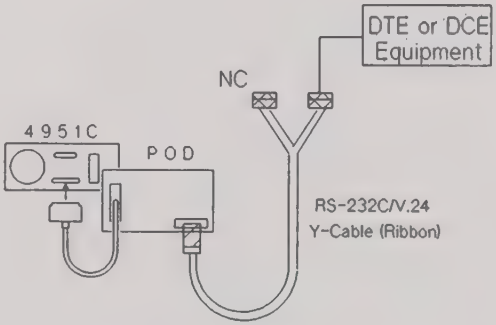


Figure 2-2. Simulation Hookup

STEP 2: SETUP

Use the Setup Menus to configure the HP 4951C to your system.

What If You Don't Know the Setup ?

You must know your system in order to simulate. However, you can find some parameters by observing the data line during monitor operation.

1. Hook up the HP 4951C for monitoring.
2. Use Auto Configure to find system parameters.
3. After monitoring for a few moments, go to the Examine Data Menu and look at the buffer data. To see the setup, press the <Timer & Counter> softkey.
4. Auto Configure selects SDLC for bit oriented protocols, and Char Async/Sync for character oriented protocols. You must observe the data in the buffer to find the exact Level 2 and Level 3 protocol on your line.

Setup Notes

- If DTE clock, Bits/sec, and Sync/Async (Char Async/Sync Menu) selections are incorrect, no data can be received or displayed.
- Protocol, data code, and error checking must be correct to ensure response by the device at the other end.

STEP 3: SIMULATE MENU SELECTIONS (Data and Triggers)

Make the following entries in the Simulate Menu.

Select DTE or DCE

Determine whether the HP 4951C is to be a DTE or a DCE. The HP 4951C sends data on pin 2 for simulating a DTE and sends data on pin 3 for simulating a DCE.

Handshaking

Determine the handshaking requirements on the leads. Use the <Set Lead> softkey to turn the leads on or off at the desired time. The HP 4951C normally sets all leads "off" before a test. The device at the other end may not respond if the appropriate control leads are not turned on or off at the proper times.

Transmitting Data

Use the <Send> softkey to enter the characters to be transmitted, otherwise the HP 4951C only sends idles. You must know the protocol and polling sequences being used on your line to ensure correct responses.

Other Entries

You can also set triggers, count events, measure time intervals, etc., in the Simulate Menu (See Chapter 6).

STEP 4: RUNNING THE TEST

To execute a simulation program, use the Run Menu: Press <Run> on the Top Level Menu and select <Simulate>.

When simulation starts,

1. All counters and timers are reset to zero.

2. The HP 4951C turns on or off the leads as specified. Observe the pod LCDs or LEDs for lead activity, or use the Data & State display format.

3. The HP 4951C, acting like a DTE or DCE, sends out the specified data. Observe the pod LCDs or LEDs and the display.

4. In synchronous setups, the ETC clock is automatically provided when simulating a DTE. The TC and RC clocks are automatically provided when simulating a DCE. You must make the correct **clock source** setup selection to monitor the DTE line.

5. Line data and lead activity, from the HP 4951C and the other transmitting device, is stored in memory.

6. The display shows the data as it is stored in memory.

Press EXIT to stop the test. The last data loaded into memory is displayed. To execute the program again, press <Run Menu> on the Top Level Menu, and then <Simulate>.

III. Bit Error Rate Tests

Bit error rate tests measure the number of bit errors on a line: how often are "highs" changed to "lows", and vice versa. For more detailed descriptions see Chapter 9.

BERT STEPS

1. Hookup

a. End-to-End. Substitute an HP 4951C for the DTE at both ends of the line. (Figure 2-3).

b. Loopback. Substitute an HP 4951C for only one DTE and "loopback" the modem or terminal at the other end of the line. (Figure 2-4).

2. Setup

Press <BERT> on the Top Level Menu and make the appropriate selections. NOTE: Select EXT for bits/sec and no framing on synchronous systems.

3. Running

Press <Run Menu> on the Top Level Menu. In the Run Menu, press <BERT>. The HP 4951C begins transmitting and receiving, and the display shows test status. Press EXIT to halt the test.

"QUICK BROWN FOX" AND STARTUP TESTS

Use the Simulation Menu to perform these tests. See the examples in Chapter 14.

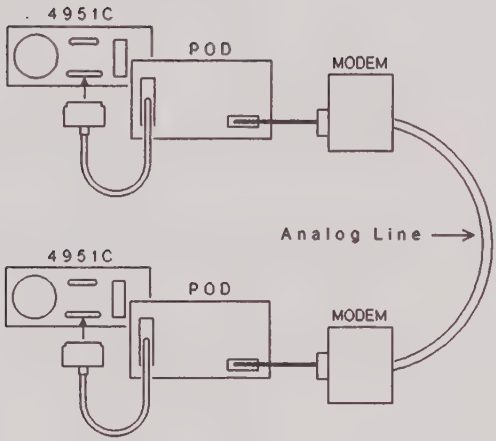


Figure 2-3. End-to-End BERT Hookup

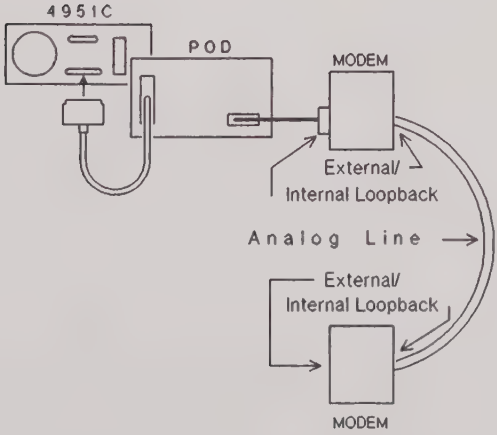


Figure 2-4. Loopback BERT Hookup

3

Self Demonstration

Introduction

This chapter is for those who learn best by doing. In this chapter you will use the Setup, Monitor, Simulate, and Examine Data Menus. Follow the steps to become familiar with your HP 4951C.

This chapter is optional. The HP 4951C with Auto Configure is easy to operate. Just hook it up to the line, press Auto Configure and begin monitoring. To make any measurement or change any setup, just press a softkey. The softkey labels prompt you with the next choice.

SUMMARY OF STEPS

1. Connect the HP 4951C to the Interface Pod.
2. Set up the HP 4951C for protocol, data code, and bit rate.
3. Simulate a DCE: Control the interface leads and transmit strings.
4. Run the simulate program.
5. Observe the captured, looped-back data in the buffer.
6. Run a monitor program from buffer.

STEP 1: HOOK UP TO THE POD

Turn off the HP 4951C. Connect the analyzer to the interface pod, as shown in Figure 3-1 below.

CAUTION

Always turn off the analyzer before connecting and disconnecting the pod.

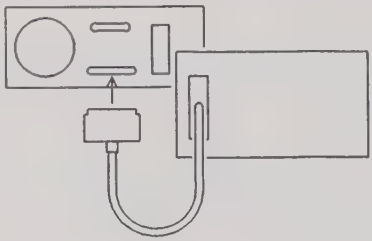


Figure 3-1. Hooking Up An Interface Pod

STEP 2: SETUP

Switch the HP 4951C on. Press <More>. Press <Reset> in the Top Level Menu, this sets all menus to their default parameters. You do not normally need to do this. Most of the time, you will want to take advantage of the HP 4951C's nonvolatile memory, which saves setups and buffer data after turn-off. Use <Reset> here to ensure a common starting setup.

Press <Setup> in the Top Level Menu. Select **Char Async/Sync** as the Setup Menu by pressing <Char>. Use the cursor and return keys to change fields. Make sure your setup has the following parameter entries:

Code: ASCII 8	Bits/sec: 1200
Mode: Synchronous	Display mode: Data & State
DTE clock: DCE	Suppress: None
Sync on: 1_6 1_6	Err chk: None

STEP 3: PROGRAM THE SIMULATE MENU

In this step you program the analyzer to transmit characters and to turn on interface leads at the right time. In normal simulation, the correct leads must be set on and off, or the terminal on the other end of the line might not accept the message.

Press <Simulate> in the Top Level Menu. Use the cursor and return keys to change fields. Select **<DCE>** as the device to simulate.

Enter the following program.

```
Block 1:    Set Lead     CD  On
            and then
            Send SYSYSXABCDEEX
            and then
            Wait         200
            and then
            Set Lead     CD Off
            and then
            Wait         200
            and then
            Goto Block 1
```

This program causes the HP 4951C to repeatedly turn on lead CD and send the character string ABCDE. The 200 millisecond delay makes it easier to see CD transitions.

In character oriented protocols, you must explicitly enter the sync characters, such as $^{S}_{Y}$ $^{S}_{Y}$, to ensure that the receiving device accepts the message. Use the CNTL key to enter control characters: CNTL "V" for $^{S}_{Y}$, CNTL "B" for $^{S}_{X}$, CNTL "C" for $^{E}_{X}$, etc.

STEP 4: RUN THE SIMULATE PROGRAM

Press <Run Menu> in the Top Level Menu, then <Simulate>. The HP 4951C begins transmitting the character string, displaying what it is transmitting, and then storing it in the buffer. The data appears as if it were coming from the line. Note the following features:

Pod with LCD Indicators (18174A, 18180A)

Four interface pod LCD indicators should be blinking: TC, RC, RD, and CD. If you were simulating a DTE (with DTE as clock source), the ETC, TD (DTE), and RTS leads would blink if programmed.

Pod with LED Indicators (18177A, 18179A Superpod)

Indicators for CD (a mark and a space) should alternate. TC and RC should be on. DCE space should flash when the message is "transmitted". CTS and DSR should have their mark indicators on.

DCE and DTE Displays

The Data & State display format shows both DTE and DCE data, as well as timing relationships on four interface leads. DCE data appears in inverse video and DTE data appears in regular video. Try changing display formats in the Setup Menu.

The <Summary> and <Stop Display> Softkeys

Press <Summary>. Without stopping the run, you can at any time review the setup and observe timer and counter activity. Press <Stop Disp>. This freezes the display, but does not halt the run.

Block Numbers

The buffer block numbers increase to 16 and then start over at 1. The buffer is a "circular buffer" and stores the last 16 blocks of information received. Once filled (16 blocks), it starts storing new information in block 1 again. A "block" of memory holds 2 Kbytes of information (data, timing information, and lead status).

STEP 5: OBSERVE THE BUFFER

During a run, data is constantly being loaded into the buffer. Press EXIT to halt the run. Press <Exam Data> in the Top Level Menu to observe the buffer. Remember that the buffer only holds the last 16 blocks of information. Note the following features:

Display Format

Go to the Setup Menu at any time to change the display format.

Character Decoding

Move the cursor through the characters. Each character is decoded in binary, hex, and octal, and its parity bit is displayed.

Bit Shifting

Note "shift = 0" at the top of the display. Press MORE to show the <bit shift> softkey. Because this is a character oriented protocol, you can shift bits up to one less than the size of the data code (e.g., six places in ASCII 7) while observing the change in the characters. This is useful in finding the correct character framing in unknown protocols.

Timer and Counter Display

Press <Timer & Cntr>. This shows you the setup and the state of the timers and counters at the end of the run.

STEP 6: RUNNING A MONITOR PROGRAM

Now that you have data in the buffer, you can repeatedly run monitor programs from buffer. Press <Monitor> in the Top Level Menu. Enter the following program:

```
Block 1:    When DCE A
              then goto Block 2
Block 2:    Start timer 1
            When DCE G
              then goto Block 3
Block 3:    Stop timer 1
```

This program measures the time interval between the start of the data string and the end.

Each timer statement is tied to the <When> trigger statement preceding it. This is the correct way to measure time. Time measurements must be referenced to a specific event with a preceding <When> trigger statement.

In Block 3 you could use "Stop Tests", which also stops the timer.

Go to the Run Menu and press <Monitor Buffer>. Data is now displayed, just as if you were running on-line.

In the Examine Data Menu press <Timers & Counters>. Timer 1 should show 40 msec (+/- 1 msec).

OBSERVING THE DTE CHANNEL

Up to now you have been able to observe what you are sending on the DCE channel because the HP 4951C always displays what it is sending.

To observe both channels, you can loop the DCE channel to the DTE channel. Use one of the small jumper wires supplied with the instrument to connect pin TD (DTE) on the interface pod to pin RD (DCE). Press <Run Menu> and then <Simulate>. You should now see DTE data (regular video) mixed with DCE data (inverse video).

4

Auto Configure

How To Use Auto Configure

Hook up the analyzer to the line for monitoring (Refer to Figure 2-1 for 'hook up' instructions). Press the <Auto Configure> softkey on the Top Level Menu. It's as simple as that!

The HP 4951C briefly displays its parameter selections in either the SDLC or the Char Asyn/Syn Setup Menu. Then it automatically goes into the Run Mode and begins monitoring. You may at anytime press the <Summary> softkey to review the Setup results.

To change the display format, or any other setup parameter, halt the run by pressing EXIT, and then go back and modify the setup in the Setup Menu. Go to the Run Menu to again start the run.

NOTE

Auto Configure alters the Setup Menu and the buffer data; so if you need the present setup and buffer data, save them on disc.

If unable to autoconfigure, the HP 4951C may not have seen enough data to make a good decision as to what's going on. Try these two suggestions to enable the HP 4951C to "lock on":

Have a large file sent from the host device to the device being monitored.

Hold the return key down on the terminal or device being monitored.

Auto Configure as a Starting Point

Auto Configure works on most lines, with most protocols and data codes. Sometimes, however, there are nonstandard protocols where Auto Configure is unable to find all the parameters. The Setup Summary that appears before monitoring in Auto Configure tells you the missing parameters. You can then go to the appropriate Setup Menu and select the correct parameters, using the procedure on page 8-8. If Auto Configure has found all the parameters, but the data does not make sense, try another data code of the same size (e.g., substitute ASCII 8 for EBCDIC). Even in the case of nonstandard protocols, Auto Configure gives you a starting point to capture data. See pages 5-22 and 8-8.

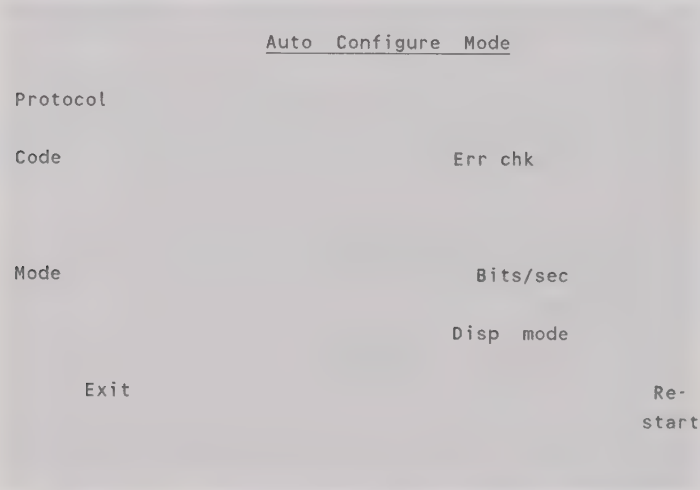


Figure 4-1. Auto Configure Display (before monitoring)

Bit Oriented Protocols

Auto Configure always selects SDLC for bit oriented protocols. Monitoring is always correct except in some cases of X.25, or HDLC with extended address and control. In these cases, the selected data code may be incorrect. Follow the procedures below.

Extended Address and Control in HDLC

To observe extended address and control on HDLC lines, go to the Setup Menu and change the protocol to HDLC. Turn on Extended Address and/or Extended Control, and change the display format to Frame & Packet. If the data does not make sense, try another data code.

Decoding Packets in X.25

To decode packet information on X.25 lines, monitor the line for a few moments to capture data in the buffer, or load the data from disc (Chapter 11). Then go to the Setup Menu and change the protocol to X.25. Change the display format to Frame & Packet. Go to the Examine Data Menu and observe the buffer data. If the data does not make sense, try another data code.

Packet information is automatically decoded in the Examine Data Menu using the Frame & Packet display format. See page 8-6.

Character Oriented Protocols

Auto Configure always selects Char Asyn/Sync for character oriented protocols. The HP 4951C finds the sync characters, data code, bit rate, etc., of most character oriented protocols.

Auto Configure and BSC

Because Auto Configure always selects Char Asyn/Syn for all character oriented protocols, you must determine the exact protocol from the parameters displayed. For example, standard BSC using EBCDIC data code would look like Figure 4-2.

Unlike standard BSC, Char Async/Sync allows full duplex operation. You can determine whether the line is standard, half duplex BSC by looking at the run-time or Examine Data display. Full duplex data looks like Figure 7-7; half duplex data looks like Figure 7-8.

Monitor/Simulate Parameter Setup

Protocol Char Async/Sync	
Bit order LSB first	Bit sense Normal
Code EBCDIC	Error Check CRC 16
Parity None	Start on S_H S_X Stop on E_X E_B E_X E_B
Transparent text char None	DTE clock DCE
Mode Sync	Bits/sec 9600
Sync on 3_2 3_2	Display mode Data & State
Drop sync 1 chrs after F_F F_F F_F F_F F_F F_F F_F	Suppress None

Figure 4-2. Standard BSC Setup Determined by Auto Configure

IPARS -- When Bit Order and Bit Sense are Changed

To monitor IPARS you must use the Character Async/Sync Set Up menu because the HP 4951C will not properly autoconfigure to the IPARS protocol, therefore you must manually set up the protocol. After initially letting Auto configure try for a few minutes, press <exit> and then <setup>.

Note that Auto Configure does not always 'lock onto' the correct **Drop sync** characters.

The most frequently used Drop sync characters used are $^{0}\underline{0}$ $^{F}\underline{F}$. You may have to place those in the setup initially found by Auto Configure. An example setup menu is shown on the next page.

On standard IPARS, the bit sense is inverted (1's are changed to 0's and vice versa), and the bit order is reversed (MSB is sent first). When Auto Configure recognizes an IPARS protocol, it automatically inverts the bit sense and reverses the bit order before storing the data in buffer memory. Thus, the data can be easily read when it appears on the display.

In some IPARS protocols the data has a different bit order and bit sense than the sync characters. Auto Configure always sets the bit sense and order so the sync characters are 3F 3E on the display. Thus, Auto Configure correctly captures and frames the data, but the displayed data may not make sense. Go to the Char Async/Sync Setup Menu and change the bit sense and/or bit order. Then look at the data again.

Monitor/Simulate Parameter Setup

Protocol Char Async/Sync	
Bit order MSB first	Bit sense Invrt
Code IPARSO	Error Check CRC 6
Parity None	Start on 3_E 3_E (HEX)
	Stop on 0_D 1_D 2_D 3_D (HEX)
Transparent text char None	DTE clock DCE
Mode Sync	Bits/sec 2400
Sync on 3_F 3_E (HEX)	Display mode 2 LINE
Drop sync 0 chrs after 0_0 3_F F_F F_F F_F F_F F_F	Suppress None

Figure 4-3. IPARS Setup Determined by Auto Configure

Figure 4-3 is a set up menu for three major airlines. The bits-per-second selection will vary for each of the networks. The same set up is used for simulation except that the data code should be set for **IPARS1** when the line idles in **1's** or **IPARS0** when the line idles in **0's**. Either of these selections may be used when monitoring this protocol.

Auto Configure Assumptions

Auto Configure makes the following assumptions. If one or more of the following requirements are violated, Auto Configure may select IPARS as the data code. If you know that your line does not use IPARS, check that your line data satisfies these requirements.

1. Both data and idle conditions must be present. Asynchronous protocols must have a minimum of two idle characters between messages.

2. A transmit (TC or ETC) clock (x1) must be present for synchronous data. In synchronous NRZI mode, the clock must be encoded with the data.

3. Synchronous character oriented protocols must have sync characters present at least once in a 50 to 100 character sequence; and the sync pattern must be preceded by two idle characters.

4. Auto Configure requires a variety of alphanumeric, control, and binary characters in the data. There must be non-repetitive data of different types for Auto Configure to make an identification. For example, if only lower case ASCII characters are sent, EBCD code might be selected.

5. There must be at least one "0" bit preceded and followed by a "1" bit, and one "1" bit preceded and followed by a "0" bit, in a 50 to 100 character sequence.

6. In bit oriented protocols, there must be at least one good **F**rame **C**heck **S**equence (FCS).

7. In bit oriented protocols, at least one frame must be less than 255 characters in length.

Auto Configure Error Messages

No data present: There is no line data. Both data and idle conditions must be present.

No Idles: There are insufficient idles on the line. Both data and idles must be present. Asynchronous protocols must have a minimum of two idle characters between messages.

No pod attached: The pod is not attached.

No Sync Characters: Could not find any of the sync characters listed on page 4-10.

Nonstandard Baud Rate: The bit rate is not within 5% of those listed on page 4-9.

Baud rate > 19200 bps: Auto Configure may work at higher rates.

Framing error: Could not find a "1" stop bit in an asynchronous protocol. This error may occur because a transmit clock (TC or ETC) is missing in a synchronous protocol. The HP 4951C assumes an asynchronous protocol, but cannot then find the stop bit.

Auto Configure Operating Characteristics

	BIT ORIENTED (SDLC)	CHARACTER (Synchronous)	CHARACTER (Async)
Mode	Sync, NRZI		Async (1 stop bit needed)
Code	ASCII 8, EBCDIC	ASCII 7, ASCII 8, EBCDIC, EBCDIC, Hex,6,7,8; IPARS (0 idle), IPARS (1 idle), Transcode	ASCII 7, ASCII 8, EBCD, Baudot
Parity		None, Odd, Even, Ignore	None, Odd, Even, Ignore
Err Chk	CRC-CCITT	None, CRC-6, CRC-12, CRC-16, LRC, (IPARS: CRC-6 only) (Hex: no error checking)	None, CRC-6, CRC-12, CRC-16, LRC
DTE Clock Source	DTE, DCE	DTE, DCE	
Speed	(Within +/- 5 % , NRZI within +/- 0.5%)		
	50, 75, 110, 134.5 150, 200, 300, 600, 1200, 1800, *2000, 2400, 3200, 3600, 4800, 7200, 9600, *12k, 14.4k, *16k, 19.2k (* not NRZI)	50, 75, 110, 134.5 150, 200, 300, 600, 1200, 1800, 2000, 2400, 3200, 3600, 4800, 7200, 9600, 12k, 14.4k, 16k, 19.2k	50, 75, 110, 134.5 150, 200, 300 600, 1200, 1800 2000, 2400, 3200 3600, 4800, 7200 9600, 19.2k

	BIT ORIENTED (SDLC)	CHARACTER (Synchronous)	CHARACTER (Async)
Sync Chars	Flags (7E)	EBCDIC: 32 32 ASCII: 16 16 IPARS: 3F 3E Transcode: 3A 3A Hex: LSB of sync char must = 0 and both sync chars must be the same	
Transparent Text		EBCDIC: DL (10) ASCII: DL (10) Transcode: DL (1F) None	(Same as Synchronous)
Start BCC		EBCDIC: SX (02) or SH (01) ASCII: SX (02) or SH (01) Transcode: SX (0A) or SH (00)	(Same as Synchronous)
Stop BCC		EBCDIC: EX (03) or EB (26) ASCII: EX (03) or EB (17) Transcode: EX (2E) or EB (0F) Will not support ITB	(Same as Synchronous)
Bit Order	LSB 1st	LSB 1st, IPARS: MSB 1st	LSB 1st
Bit Sense	Normal	Normal, IPARS: Inverted	Normal
Idle Char	7E	FF, IPARS: FF or 00	FF

5

The Setup Menus

How Setup Controls Other Menu Selections

Setup, whether performed manually or via Auto Configure, determines some choices in the other menus. For example, error checking is performed during monitoring according to the current setup. The appropriate error checking characters are automatically appended to Send strings. Data is displayed in the Examine Data or Run Menus according to the current setup. See Chapter 7.

THE FIVE SETUP MENUS

Press <Setup> on the Top Level Menu to access the Setup Menus. Move the cursor to the Protocol field and select one of the following:

HDLC (bit oriented)	Allows extended address and control fields.
SDLC (bit oriented)	Allows NRZI synchronizing. This setup is always selected when Auto Configure recognizes a bit oriented protocol.
X.25 (bit oriented)	Packet information is decoded in the Examine Data Menu
BSC (character oriented)	Supports standard half duplex, character oriented BSC.
CHAR ASYNC/SYNC	May be used to configure to most protocols. This setup is always selected when Auto Configure recognizes a character oriented protocol.

WHEN TO USE THE SETUP MENUS

When monitoring on-line, Auto Configure can automatically configure the HP 4951C to most lines. Generally, however, use the Setup Menus for the following:

KNOWN LINE PARAMETERS. If you know what the line parameters are, manually configuring may be faster and more accurate than Auto Configure.

MONITORING FROM BUFFER. For post-processing, use the setup menus. You can of course, use an "auto configured" setup from a previous run. Setups remain even after power off, unless you press <Reset>.

CHANGING DISPLAY FORMATS. Auto Configure always uses the display format currently selected in the Setup Menu. Use the Setup Menus to change display formats.

SUPPLEMENTING AUTO CONFIGURE. Use the Setup Menus to modify any parameters after initial setup with Auto Configure.

SIMULATING. Use the Setup Menus to determine send string format.

SAVING SETUPS

NONVOLATILE MEMORY. To save menu setups and buffer data, turn off the power only when in the Top Level Menu. Otherwise, some settings may be destroyed.

DISC STORAGE. You can store Menus, or both Menus & Data, to disc. All menus except BERT are saved. See Chapter 11.

The Bit Oriented Menus

The three Bit Oriented Setup Menus are HDLC, SDLC, and X.25. Press <Setup> on the Top Level Menu and select HDLC, SDLC, or X.25.

To decode frames in bit oriented protocols, use Frame & Packet display mode. To decode X.25 packets, use the Examine Data Menu in frame & packet format.

The Bit Oriented Setup Menu, and the softkey options, are shown on page 5-5. Asterisks indicate differences between the three protocols. The default parameter selections, which appear after <Reset>, are listed in Chapter 12.

In Bit Oriented Setup, the HP 4951C performs automatic zero bit insertion/extraction.

HDLC and SDLC PROTOCOLS

Except for the following differences, HDLC and SDLC have the same format.

1. HDLC allows Extended Address and Control fields.

2. SDLC allows either normal Sync Mode or NRZI Sync.

X.25 PROTOCOL

X.25 is the same as HDLC except for allowing ISO Level 3 (network) data to be placed in the information field of Information Frames. Use the X.25 menu when monitoring or simulating X.25 lines. The Examine Data Menu decodes packets in Frame & Packet display format. See Chapter 8.

```
Monitor/Simulate Parameter Setup

Protocol      SDLC

Code   ASCII 8    Err chk   CCITT
Parity    None

                   DTE clock  DCE
Mode       Sync      Bits/sec   9600

                   Disp mode  D & S

HDLC SDLC X.25  BSC  Char
```

Figure 5-1. SDLC Setup Menu

BIT ORIENTED PROTOCOL SETUP MENUS

(* used only in HDLC)
(** used only in SDLC)

```
Protocol   [ HDLC ]
           [ SDLC ]
           [ X.25 ]

* Ext Addr  [ Off ]        * Ext Ctrl   [ Off ]
            [ On  ]                     [ On  ]

Code   [ ASCII 8 ]          Err chk      CCITT
       [ Hex 8   ]
       [ EBCDIC  ]

                            DTE clock  [ DCE ]
Parity      None                       [ DTE ]

Mode        Sync            Bits/sec   [ 19200 ] [  3600 ] [  200 ] [ 16000 ]
     ** [ Sync NRZI ]                   [  9600 ] [  3200 ] [  150 ] [ 14400 ]
                                        [  7200 ] [  2000 ] [134.5 ] [ 12000 ]
                                        [  4800 ] [  1800 ] [  110 ] [Teletext]
                                        [  2400 ] [   600 ] [   75 ]
                                        [  1200 ] [   300 ] [   50 ]

                            Disp mode  [ Two Line ]  [   Data & State ]
                                       [ DTE only ]  [ Frame & Packet ]
                                       [ DCE only ]
```

BIT ORIENTED MENU DEFINITIONS

EXT ADDR (HDLC)	HDLC allows an extended address field. When an additional address octet (byte) is to follow, the first or least significant bit of the address octet is set to 0. The last address octet in a series has the LSB set to 1.
EXT CTRL (HDLC)	HDLC allows a 16-bit control field to handle larger N(S) and N(R) counts.
CODE	The bit-oriented menus allow ASCII 8, EBCDIC or, using Hex 8, any 8-bit code.
MODE	All bit-oriented protocols are synchronous: the data is transmitted with a clock. In NRZI (SDLC only) the clock is encoded within the data.
DTE CLOCK	DTE data can be synchronized to either a DCE or DTE clock. If this selection is incorrect, only DCE data will be displayed.
DISP MODE	All five display formats are available for the bit oriented menus. The Frame & Packet format decodes all control field bits. In addition, when viewing the buffer in this format, packet information is also decoded. See Chapters 7 and 8 for examples of the different types of displays.
BITS/SEC	Except for NRZI, all the selections shown on page 5-5 are supported. NRZI may not work at 16000, 12000, and 2000 bps. In Teletext, the DTE sends at 75 bps, and the DCE sends at 1200 bps.

HINTS FOR SETTING UP BIT ORIENTED LINES

Observe the Pod

The pod LCDs or LEDs marked DTE and DCE should be flashing. Except in the case of NRZI sync, there should also be clock activity.

Use Auto Configure

Use Auto Configure for initial setup. If the data is bit oriented, Auto Configure always selects SDLC as the protocol. You will have to change protocols in the following cases.

1. HDLC with Extended Address or Control. Change the protocol to HDLC with the following setup:

   ```
   Ext Addr and/or Ext Ctrl: On          Disp mode: Frame & Packet
   ```

2. X.25 Packets. If the protocol is X.25, change the setup to the following. After capturing data, use the Examine Data Menu to observe packet decoding.

   ```
   Protocol: X.25                        Disp mode: Frame & Packet
   ```

Choose the Appropriate Display Format

In the bit oriented menus, you can use any of the five display formats. For frame decoding, use Frame & Packet, as described on the following pages.

DECODING FRAMES WITH FRAME AND PACKET DISPLAY FORMAT

During run-time, the Frame & Packet display format decodes Level 2 frame information in HDLC, SDLC, or X.25. The frame information described below is decoded. See Figure 5-2.

After run-time, for HDLC or SDLC, the Frame & Packet display looks the same when observing the buffer in the Examine Data Menu, except that up to 57 data characters can be shown at the top of the display. See Figure 5-3.

ADDRESS	Hex address of the secondary channel. Extended addresses can be seen when HDLC with extended address is being used.
TYPE	Identifies the type of frame from the Control Field.
N(S)	Send Sequence Number of the frame. Normally modulo 8; but becomes modulo 128 when HDLC with extended control is being used.
P/F	Poll/Final Bit. In the command mode this bit is a P-bit and is normally "0". If the primary requires an immediate response from the secondary, it sets the P-bit to a "1". The subsequent response is identified, since the Final bit is set to a "1".
N(R)	Receive Sequence Number of the frame. Normally modulo 8; but becomes modulo 128 when HDLC with extended control is being used.
Data	Displays the first nine characters of the information field.
FCS	Indicates the status of the Frame Check Sequence (CRC-CCITT) as either good (GG), bad (BB), or indicates an aborted frame (AA).

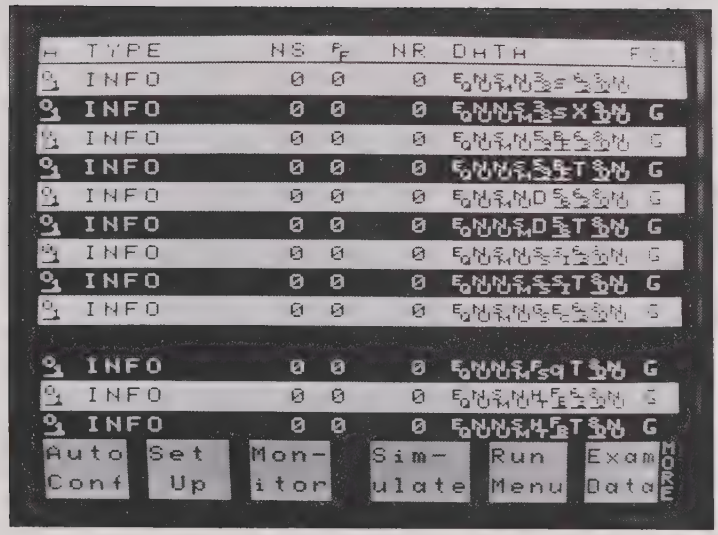


Figure 5-2. HDLC in Frame & Packet Display Format (run-time)

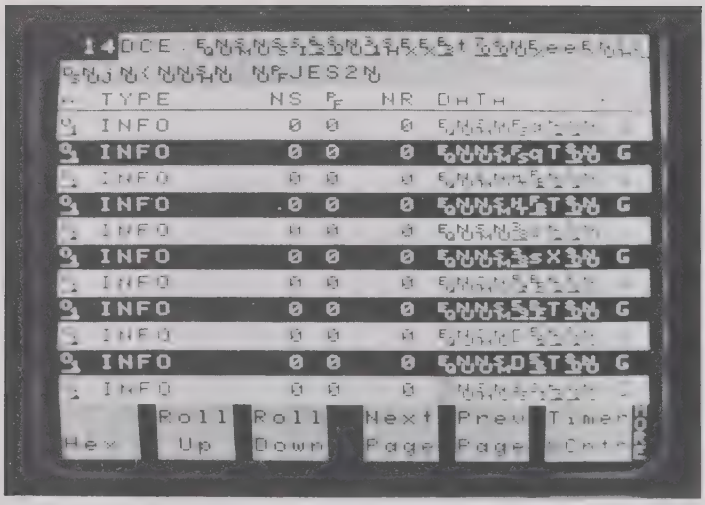


Figure 5-3. HDLC in Frame & Packet Display Format (Examine Data Menu)

DECODING X.25 PACKETS IN THE EXAMINE DATA MENU

X.25 looks the same as HDLC or SDLC when running in the frame and packet display format. After capturing data, however, the Examine Data Menu shows both frame decoding and packet decoding. As shown on the next page, packet information at the cursor location is decoded at the top of the display. The top of the display contains the following information.

Origin	DTE or DCE.
Q-Bit	Qualifier Bit.
D-Bit	Delivery Confirmation Bit.
MOD	Modulo 8 or 128.
LCN	Logical Channel Number.
TYPE	Type of packet.
P(S)	Packet Send Sequence Number.
M-Bit	More Data Mark.
P(R)	Packet Receive Sequence Number.
Data	Displays the first five characters of the data field.

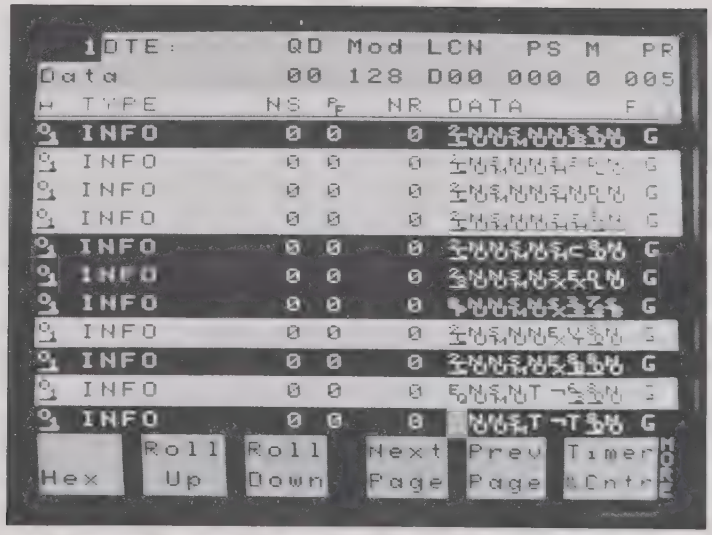

1 DTE: QD Mod LCN PS M PR
Data 00 128 D00 000 0 005
TYPE NS PF NR DATA F
INFO 0 0 0 G
INFO 0 0 0 G
INFO 0 0 0 G
INFO 0 0 0 G
INFO 0 0 0 G
INFO 0 0 0 G
INFO 0 0 0 G
INFO 0 0 0 G
INFO 0 0 0 G
INFO 0 0 0 G
INFO 0 0 0 G
Hex
Roll Up
Roll Down
Next Page
Prev Page
Timer &Cntr
HOLD

Figure 5-4. X.25 in Frame & Packet Display Format (Examine Data Menu)

The BSC Menu

The BSC Menu and available softkey selections are shown on the following page.

PARITY — BSC specifies odd parity for ASCII 7. There is no parity check for EBCDIC or Transcode. The HP 4951C automatically sets the parity condition for the chosen code. In simulate mode, BSC is transmitted with the correct parity.

Note: If "Send" or "When" characters are specified in hex, the parity bit is not changed to conform to the parity setup selection.

MODE — BSC is synchronous.

SYNC ON — The HP 4951C automatically chooses the correct sync characters for each data code. The sync characters are: $^{3}_{2}$ $^{3}_{2}$ (EBCDIC), $^{1}_{6}$ $^{1}_{6}$ (ASCII), or $^{3}_{A}$ $^{3}_{A}$ (Transcode). The HP 4951C requires at least two sync characters for proper framing.

ERR CHK — Select LRC or CRC-16 for ASCII or EBCDIC, and select LRC or CRC-12 for Transcode.

BITS/SEC — The bit rates for BSC are the same as the bit oriented protocols.

DISP MODE — Frame & Packet display format is not used in BSC.

SUPPRESS — The BSC Menu lets you suppress almost any combination of text and control characters from the display. However, suppressed characters are not deleted from the buffer. Note that idle characters are assumed to be FF in BSC.

BSC SETUP MENU

```
Protocol  [ BSC ]

Code  [ ASCII 7   ]          Err chk    [ LRC    ]
      [ Transcode ]                     [ CRC 12 ]
      [ EBCDIC    ]                     [ CRC 16 ]

Parity   Odd  (ASCII 7)      DTE clock  [ DCE ]
         None (Transcode)                [ DTE ]
         None (EBCDIC)

                                Bits/sec  [ 19200 ] [  3600 ] [   200 ] [ 16000 ]
                                          [  9600 ] [  3200 ] [   150 ] [ 14400 ]
                                          [  7200 ] [  2000 ] [ 134.5 ] [ 12000 ]
Sync on   16  16  (ASCII 7)               [  4800 ] [  1800 ] [   110 ] [Teletext]
          3A  3A  (Transcode)             [  2400 ] [   600 ] [    75 ]
          32  32  (EBCDIC)                [  1200 ] [   300 ] [    50 ]

                                Disp mode [ Two Line ] [     DCE Only ]
                                          [ DTE Only ] [ Data & State ]

                                Suppress  [ None         ] [ Idle & Ctl    ]
                                          [ Idle         ] [ Idle & Txt    ]
                                          [ Null         ] [ Null & Ctl    ]
                                          [ Control      ] [ Null & Txt    ]
                                          [ Text         ] [ Id & Nu & Ctl ]
                                          [ Idles & Null ] [ Id & Nu & Txt ]
```

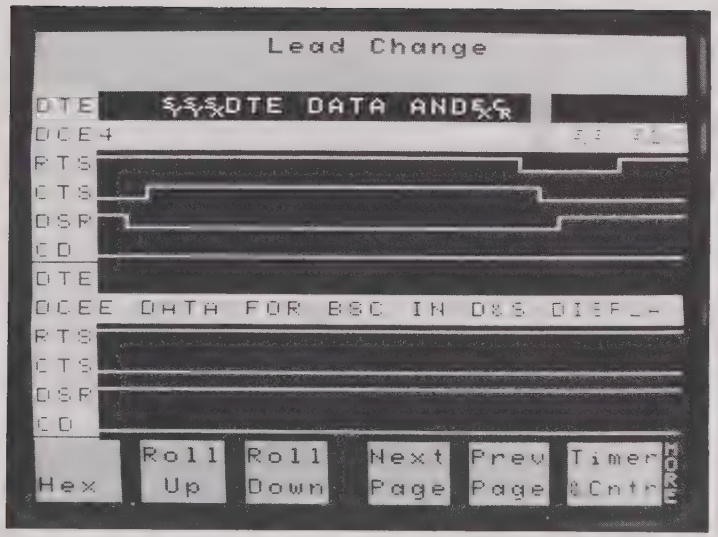


Figure 5-5. BSC in Data & State Display Format

The Char ASYNC/SYNC Menu

Shown on the next page is the Char Async/Sync Menu and its softkey selections. This Menu is a general purpose setup menu. You can use it to capture most protocols: synchronous or asynchronous.

Configuring to Any Data Code

Note the large number of codes available with this menu. In the Char Async/Sync Menu, you select all the parameters to go with your data code. This menu lets you to tailor the analyzer to many different codes with standard or nonstandard characteristics.

The HP 4951C does not perform zero bit insertion or extraction for bit oriented protocols when in Char Async/Sync setup.

When to Use the Char Async/Sync Menu

1. For asynchronous lines.
2. For full-duplex, character-oriented protocols.
3. To see all line activity, including line idles (See page 5-22).
4. For nonstandard protocols, such as asynchronous BSC.

CHAR ASYNC/SYNC SETUP MENU (* indicates synchronous mode only)

```
Bit order  [ LSB first ] [ MSB first ]          Bit sense  [ Normal ] [ Inverted ]

Code  [ ASCII 8 ] [ Hex 6  ] [ IPARS idle 0]        Err   [ CRC 6 ] [CRC 16 ]
      [ Hex 8   ] [ EBCDIC ] [ IPARS idle 1]         chk  [  LRC ] [ CRC 12 ]
      [ ASCII 7 ] [ Transcode ] [ Baudot ]               [ None ]
      [ Hex 7   ] [ Hex 5  ] [ EBCD ]

                                      * Start on/Stop on  [ Use keyboard ]

Parity [ None ] [ Even ] [ Odd ] [ Ignore ]      * DTE clock  [ DCE ] [ DTE ]


Transparent  [    None ]          Bits/sec  [ 19200 ] [ 3600 ] [   150 ] [ 16000 ]
  text char  [ Use keyboard ]               [  9600 ] [ 3200 ] [ 134.5 ] [ 14400 ]
                                            [  7200 ] [ 2000 ] [   110 ] [ 12000 ]
Mode   [ Asyn 1   ]  [ Asyn 2 ]             [  4800 ] [ 1800 ] [    75 ]
       [ Asyn 1.5 ]  [ Sync   ]             [  2400 ] [  600 ] [    50 ] [ 200 ]
                                            [  1200 ] [  300 ] [Teletxt]


* Sync on  [  Idles ]              Disp mode  [ Two Line ]  [ DCE Only ]
           [ Use keyboard ]                  [ DTE Only ]  [ Data & State ]


* Drop sync [ Use keyboard ] chrs       Suppress   [ None   ]  [ Idle & Ctl    ]
   after [ Use keyboard ] [ None ]                 [ Idle   ]  [ Idle & Txt    ]
                                                   [ Null   ]  [ Null & Ctl    ]
                                                   [ Control ]  [ Null & Txt    ]
                                                   [ Text    ]  [ Id & Nu & Ctl ]
                                                   [ Idles & Null ]
                                                   [ Id & Nu & Txt ]
```

Char ASYNC/SYNC Definitions

Bit Order/Sense. Normally, the least significant bit is sent first, and data is not inverted. Some protocols (e.g., IPARS) may be different. These selections affect only incoming and outgoing run-time data. Incoming data is changed at the input interface before processing. When simulating, data is changed at the output interface. Buffer data is not changed.

Start on/Stop on. Determines error checking bounds. Error checking starts on the character immediately after the Start On character; however, the Stop On character is included in the BCC. This selection does not appear if Error chk is None. See page 5-19 for hex entry.

Transparent Text. This character delimits the boundaries of a field, inside of which all control characters are to be treated as data. This is the same as the DLE character in BSC protocol. See page 5-19 for hex entry.

Mode. Synchronous, or Asynchronous (1, 1.5, 2 stop bits). The HP 4951C needs only one stop bit for asynchronous monitoring, even if more are present.

Sync on. Synchronous mode only. Selects the sync characters for proper framing. The HP 4951C requires at least two sync characters. The HP 4951C must see at least two of these characters to capture data when monitoring or simulating character oriented protocols. See page 5-19 for hex entry.

Drop sync after. Synchronous mode only. Tells the analyzer to "drop" sync (stop bringing in data) and start looking for sync characters again. See page 5-19 for hex entry.

DTE Clock. Synchronous mode only. Specifies the DTE transmit clock source.

Using Char ASYNC/SYNC

There are several fields in the Char Async/Sync Menu which let you make hex entries: **sync on**, **drop sync**, **transparent text**, and **start on/stop on**. Each is detailed in the following paragraphs.

HEX ENTRIES and PARITY

When making hexadecimal entries, the resulting parity bit might not conform to the parity setup selection. For example, with ASCII 7 and even parity, the sync characters should be $^{9}_{6}$ $^{9}_{6}$, rather than $^{1}_{6}$ $^{1}_{6}$. Of course, your line may still use $^{1}_{6}$ $^{1}_{6}$, even though this would result in the wrong parity for sync characters. If your line satisfies the requirements on page 4-7, you can use Auto Configure to find the correct sync characters.

For hexadecimal entries, the resulting parity bit conforms to the following rules:

1. For data codes of 7 bits or less (e.g., ASCII 7, Baudot) the parity bit is not changed to conform with setup selection.

2. For 8-bit data codes (e.g., ASCII 8, EBCDIC) the parity bit always conforms to parity setup selection.

For 8-bit data codes with parity, the selected sync characters must be the same as the last 16 bits to enter the analyzer before non-sync data. For example, in EBCDIC the normal sync pattern is $^{3}_{2}$ $^{3}_{2}$. With even parity, the binary pattern would be 100110010 100110010, or 18 bits. But only the last 16 bits are used by the analyzer as the sync pattern. Because least significant bits are sent first, the two bits in brackets are excluded from the sync pattern: 1001100[10] 100110010. Thus, you must enter $^{4}_{C}$ $^{9}_{9}$ for the analyzer to accept data. Of course, Auto Configure will find the correct sync characters for you.

SYNC CHARACTERS (Synchronous mode only)

The **sync on** selection determines what sync characters the analyzer looks for. Unless the sync pattern is correct, the HP 4951C will not capture data. The HP 4951C requires at least two sync characters (i.e., the correct 16-bit pattern) to capture data when monitoring and simulating.

When you do not know the sync characters, use Auto Configure. You can also select Sync on Idles. This allows you to load line data even without the correct sync characters.

The HP 4951C assumes that all character oriented protocols idle in FF. If your line uses some other condition, you must Sync on that condition.

DROP SYNC CHARACTERS (Synchronous mode only)

The Drop sync entry determines where the analyzer drops sync and begins looking again for the sync characters. If the analyzer did not drop sync, it would bring in all activity on the line, including idles.

Select seven characters on which to drop sync. The first character is the "within text" character. The analyzer only looks for this character if you have chosen error checking. Thus, if you start on STX and stop on ETX, the analyzer looks for the "within text" character between STX and ETX.

Normally, the HP 4951C does not store idles. This is to prevent the buffer from being filled inefficiently.

To store all data, including idles, enter **Drop sync** 0 **chrs after** None. The analyzer never drops sync, and brings in all line data, including idles.

Drop Sync and Error Checking

The Drop sync selection interacts with the Error check selection in the following ways.

1. The first drop sync character specifies "within text". The analyzer looks for this character between the start on and stop on error checking limits. When error checking is "none", all text is outside, and the analyzer does not look for the first character.

2. The last six drop sync characters specify "outside text". The analyzer looks for these characters outside the start on and stop on error checking limits. The six "outside text" characters are ORed: the analyzer drops sync on any one of them that occurs outside the error checking limits.

3. The first, or "within text", character takes precedence over the six "outside text" characters. If the same character occurs both inside and outside the start on and stop on limits, the analyzer drops sync within text.

4. With error checking, the analyzer always drops sync after the BCC character(s) if it cannot find a "within text" character. For example, if you select CRC-16 error checking, with Start on STX and Stop on ETX, the analyzer drops sync after the two characters following ETX.

For example, **Drop sync 1 chrs after** $^{B}_{B}$ $^{F}_{F}$ $^{F}_{F}$ $^{F}_{F}$ $^{5}_{D}$ $^{A}_{4}$ $^{B}_{3}$ causes the analyzer to drop sync one character after the first $^{B}_{B}$ character within the specified error checking limits. If the analyzer does not find the specified "within text" character, it drops sync either after the BCC character(s) or after one of the six "outside text" characters, whichever appears first.

Capturing Unknown Data

The following methodologies are presented to aid when the user does not know all the details of the data to be monitored. Consider each one in respect to what is known and utilize as applicable.

CAPTURING THE DATA

For nonstandard protocols in which Auto Configure may not work, perform the following procedure.

1. For unknown data codes, try an 8-bit code first. Select no parity and no error checking.

2. To load line data for study when you do not know the sync character, select Sync on idles.

   The HP 4951C assumes that all character oriented protocols idle in $^{F}_{F}$. If your line uses some other idle character, you must sync on that character.

3. To store all data for study, including idles, enter **Drop sync** 0 **chrs after** None. The analyzer never drops sync and brings in all data, including idles.

   Normally, idles are not stored to make efficient use of the buffer.

4. After making the above selections in the Char Async/Sync Menu, go to the Run Menu and <Monitor from Line> for a few moments to fill the buffer with data for study.

5. Go to the Examine Data Menu to view the data in buffer.

The buffer data will probably be meaningless because of incorrect character framing since the analyzer does not know where each character begins or ends. Now you need to find the correct sync pattern.

FINDING THE CORRECT FRAMING

Bit Shifting (BSC and Char Async/Sync only)

Bit shifting does not work when data is brought in Most Significant Bit (MSB) first.

Even if you do succeed in bringing in data by synchronizing on idles, the displayed information will probably be meaningless because of incorrect framing. To make the data meaningful, go to the Examine Data Menu and <Bit Shift> the captured data.

The HP 4951C does not shift through the parity bit. Unless you use a code with no parity you must use trial and error to find the correct framing.

If part of the data still does not become meaningful while bit shifting, change the data code to one without parity. When the data becomes meaningful, you can determine the correct sync characters. Change the Sync on selection to these characters.

ELIMINATING SUPERFLUOUS DATA

Dropping Sync (Synchronous mode only)

Once you find the correct framing through the above procedure, you can eliminate idles. Otherwise the buffer is mostly filled with idles. To eliminate idles, enter **Drop sync 0 chars after** $^{F}_{F}$. If the line idles in a character other than $^{F}_{F}$, enter that character instead.

Data Code	No Parity	Even or Odd Parity	Ignore Parity
Hex 5 Baudot	5 bits (no parity bit)	6 bits (including parity bit)	6 bits * (parity bit = 0)
Hex 6 EBCD IPARS Transcode	6 bits (no parity bit)	7 bits (including parity bit)	7 bits * (parity bit = 0)
Hex 7 ASCII 7	7 bits (no parity bit)	8 bits (including parity bit)	8 bits * (parity bit = 0)
Hex 8 ASCII 8 EBCDIC	8 bits (no parity bit)	9 bits (including parity bit)	9 bits * (parity bit = odd)

(* these settings are forced in Simulate)

Figure 5-6. Character Frame Sizes vs Data Code

6

The Monitor and Simulate Menus

This chapter explains how to make measurements. Because the HP 4951C uses triggering for all measurements, this chapter tells you how to tie your programs to trigger statements. Press <Monitor> on the Top Level Menu to access the monitor menu. Press <Simulate> to access the simulate menu.

Differences Between Monitor and Simulate Menus

Monitoring has no effect on the line: it is passive and non-interactive. Simulation is active: the HP 4951C takes the place of a DTE or DCE on the data line. There are five differences between the Monitor and Simulate Menus:

1. In Simulate, you must specify either DTE or DCE simulation.

2. In Simulate Menu, you can transmit characters with the <Send> softkey.

3. In Simulate, you must program the interface with the <Set Lead> softkey.

4. In Simulate, you can delay output (Send, Set Lead) with the <Wait> statement.

5. In Simulate, clocks are automatically provided on the interface: ETC is provided when simulating a DTE; TC and RC are provided when simulating a DCE.

6. In Simulate, when transmitting "Send" strings in bit oriented protocols, frame error checking is automatically supplied.

Programming

Always Do Setup First. If you change the setup menu after entering a program or change DTE to DCE (or vice versa) within a program, the program may have blinking entry fields indicating those entries are inappropriate for the setup. If you change the setup data code or protocol after entering a character string, you must retype the string (see pages 6-6, 6-25). The program will fail unless you change either the setup or the program.

Softkey Programming. The softkeys display only appropriate choices. Press one of the softkeys in the Monitor or Simulate Menu. Other choices will appear, leading you through the program. For example, pressing <Start> causes the new softkey choices <Display>, <Disc>, and <Timer> to appear.

Block Structure. Programs are organized in blocks. A maximum of 31 blocks is allowed. Blocks provide "reference spots" for looping back or jumping ahead.

Editing Programs. Use the third set of softkeys on the Monitor or Simulate Menu and the cursor keys. The third set of softkeys can be accessed by the MORE key when you are at the beginning of a line. Blocks cannot be inserted or deleted. It's a good idea to leave empty blocks between used blocks for future editing.

Running Programs. After the program is developed, press <Run Menu> on the Top Level Menu. Select either <Monitor> or <Simulate>, depending on whether your program is in the Monitor or the Simulate Menu. Select either <Monitor Line> or <Monitor Buffer>, depending on whether you want to monitor "on-line" or do post-processing on data already in the non-volatile buffer. The HP 4951C lets you run programs over and over on the data in its nonvolatile buffer.

Triggering

The HP 4951C stores all line data in its buffer. You can trigger on any line event. With triggering, you can selectively analyze only events of interest.

"WHEN" DEFINES TRIGGERS

"When" is the only statement that can define a trigger. Each character in a "When" string constitutes one trigger. For example, "When DTE abcd" uses four triggers. A trigger "counter" in the display shows how many triggers are left. "When Timer" statements are not included in the trigger counter.

THINGS TO REMEMBER

1. The HP 4951C can "look for" up to 63 trigger events simultaneously.

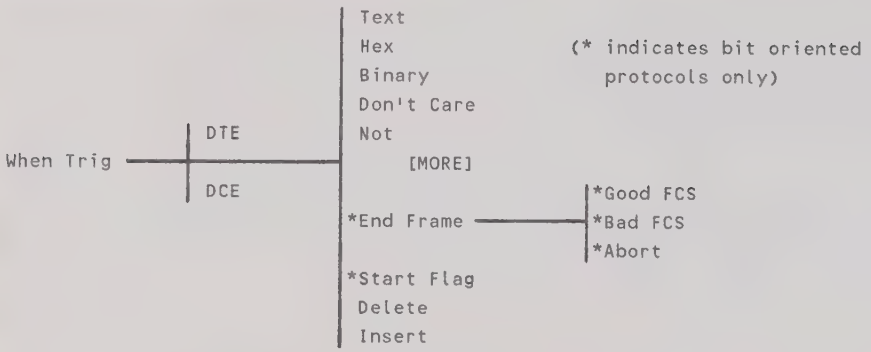
2. The HP 4951C can branch to any action as a result of a trigger. You must provide a block for the analyzer to branch to (e.g., then goto Block 4).

3. All monitor/simulate measurements must be tied to a preceding trigger statement. For example, when starting and stopping a timer, a "When" statement must precede the Start" and "Stop" statements. Thus, START, STOP, BEEP, HIGHLIGHT, and IF all refer to preceding "When" statements.

4. The program does not move out of a block containing a "When" statement until the statement is satisfied.

5. Once a trigger is satisfied, the trigger search mechanism is positioned in the buffer immediately after where the trigger was found. Thus, the next trigger does not miss any data.

Triggering on Characters



SELECTING CHARACTERS

Use the <Text> softkey for keyboard characters. The SHIFT key accesses lower-case characters, and the CNTL key accesses control characters. You can see the binary or hex value by positioning the cursor over that character and pressing <Hex> or <Binary>.

Editing Character Strings

Use the cursor keys or the <Delete> and <Insert> softkeys to edit a string. Press MORE to access these softkeys when the cursor is positioned in the string.

Changing the Setup after Typing a String

If you change the data code or protocol in the Setup Menu after typing a character string, you must retype the string to avoid sending or triggering on the wrong characters. Characters in one code may not have the same meaning in another code. When you move the cursor to that character, the HP 4951C shows "**?**" if it cannot find the hex or text equivalent in the new code. The binary value of the character can always be viewed by pressing the <Binary> softkey.

When a Character is not on the Keyboard

EBCDIC and some other data codes have control characters which are not on the keyboard. Go to the data code tables in Appendix B and find the hexadecimal equivalent. Press the <Hex> or <Binary> softkey and enter that character from the keyboard.

Binary and Hex Characters

Use the <Hex> or <Binary> softkeys to enter hexadecimal characters or binary strings. Two hex numbers occupy each character position, requiring two keyboard entries. Hex characters are underlined to differentiate them from text control characters with the same abbreviation. When you press <Binary>, eight binary bits are displayed, allowing you to enter a 1 or 0 in any bit position from the softkeys. Once you move the cursor out of the binary string, it collapses to its hex equivalent; but it is underlined to indicate it was entered in binary.

If the data code selected in the Setup Menu is less than eight bits (e.g., Baudot or Transcode), the appropriate number of higher order bits are disregarded.

Masking out Characters

Use <Don't Care> to mask out string characters or bits of no interest. "Don't Care" characters are denoted by a boxed "**X**". If any bit in a binary string is designated as "don't care", the compressed character is denoted by "**?**". See Figure 6-1.

Excluding Characters

To trigger on "anything but" a particular character, use <Not>. "Not" characters are overlined. Observe the "3" and "5" in Figure 6-1.

Flags and Frame Check Characters

Unlike <Send> strings, flags and frame check characters are not automatically appended for <When Trig> strings. You can enter these characters using the MORE key. The MORE key accesses the "End Frame" characters (the FCS characters and the last flag). End Frame characters may be useful if you wish to trigger on Bad FCS or Abort Characters. Triggers for FCS errors or abort characters can only be programmed when a bit oriented protocol is selected on the setup menu.

Parity

When triggering on a character, the HP 4951C ignores the parity bit. You can see this by expanding the specified trigger character in binary when the setup is ASCII 7. The most significant (left) bit is designated "don't care" by a boxed "**X**". You can explicitly define this character by entering a 1 or 0 in binary. This overrides the Setup Menu. Triggers for parity errors can only be programmed when a character oriented protocol is selected in the setup menu.

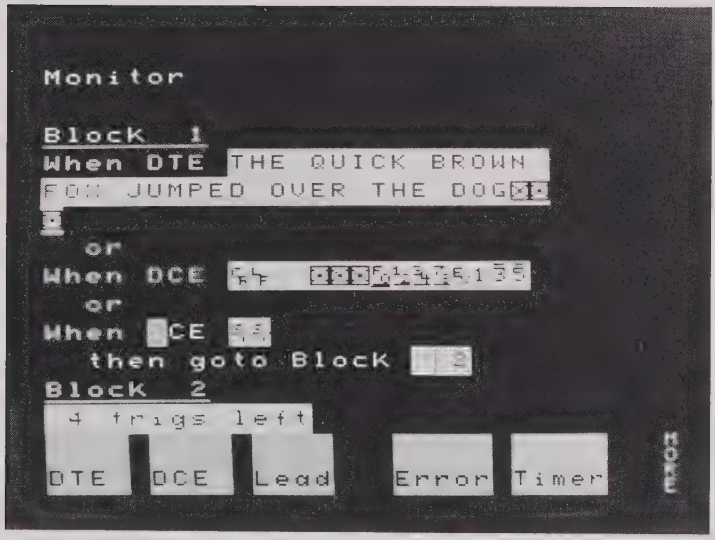
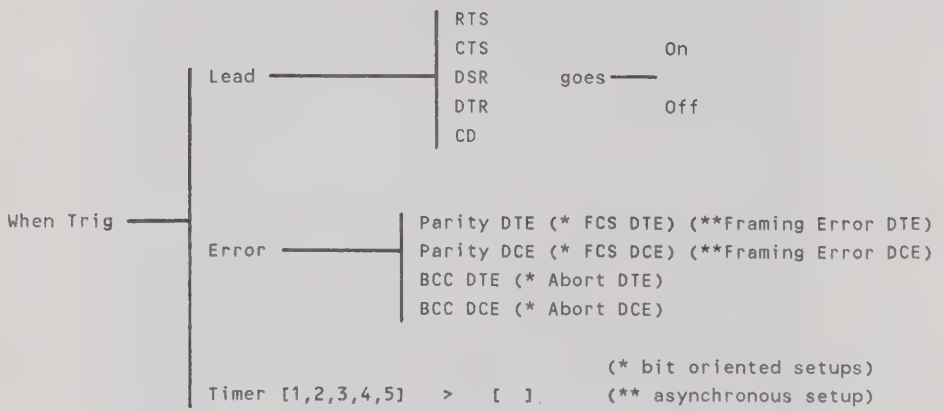


Figure 6-1. Triggering on Characters

Triggering on Errors, Leads, Timers



Leads. Only the RS-232C/V.24 leads are shown above. If a different pod, such as RS-449, is connected, those leads appear as softkey choices.

Types of Errors. BCC (Block Check Characters) and Parity errors are used only with character protocols. FCS (Frame Check Sequence) is used only with bit oriented protocols. Framing Errors appear only in asynchronous setup (Char Async/Sync Menu). The error softkeys appear automatically, according to the current Setup.

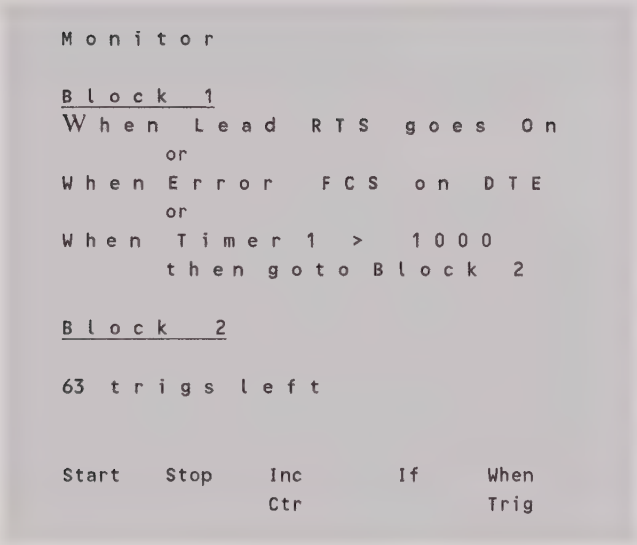


Figure 6-2. Triggering on Errors, Leads, Timers

Combining Triggers

<When Trig> statements within the same block are ORed: the analyzer looks for them all simultaneously. If two are satisfied simultaneously, the first one listed takes priority. To sequence <When Trig> statements, put them in separate blocks.

HOW TO "OR" TRIGGERS

The <When Trig> statements in this example are ORed. The analyzer looks for all four simultaneously. Once a trigger is found, all other triggers in that block are disabled. If two <When Trig> statements are satisfied simultaneously, only the first one in the block is recognized. Note: You must have a character oriented protocol selected in the setup menu for this example.

```
Block 1:    When DTE  abcd
                then goto Block 2
            When Error  Parity on DTE
                or
            When Error  Parity on DCE
                then goto Block 3
            When Lead  RTS goes On
                then goto Block 4
```

HOW TO SEQUENCE TRIGGERS

In this example, the HP 4951C must find the string "abcd" before it can look for string "efgh". To get to block 5, the analyzer must find both strings in order.

```
Block 1:        When DTE  abcd
                    then goto Block 2

Block 2:        When DTE  efgh
                then goto Block 5
```

OVERLAPPING TRIGGERS

For overlapping triggers, the trigger found first disables the other triggers.

In this example "ab" is always found first and then disable the first <When Trig> statement.

```
Block 1:   When DTE  abc
               then goto Block 2
           When DTE  ab
               then goto Block 3
```

In this example if the data is "yabc", only the first <When Trig> is satisfied. If the data is "ybc" only the second <When Trig> is satisfied. If the data is "yc", only the third <When Trig> is satisfied. The first <When Trig> to be satisfied disables the others.

```
Block 1:   When DTE  abc
               then goto Block 2
           When DTE  bc
               then goto Block 3
           When DTE  c
               then goto Block 4
```

In this example if the data is "ybc", only the trigger "c" is found.

```
Block 1:   When DTE  c
               then goto Block 2
           When DTE  bc
               then goto Block 3
```

Measuring Time Between Triggers

The HP 4951C has five timers which can each measure up to 65,535 milliseconds. Timers are always reset to zero at the beginning of a run (i.e., when you press <Run Menu>). Timers are reset under program control with <Reset>. Timers are stopped under program control with <Stop Timer> or <Stop Tests>. In bit oriented protocols, the start flag and address of a string have the same time mark. This is also true of the last character and the end flag.

As shown in the following examples, statements using timers or leads relate to the status of the line at the time of the last trigger. You should always make sure statements relating to line status are tied to a preceding trigger statement.

INCORRECT WAY TO MEASURE TIME

Timer 1 now starts when the run begins, rather than when RTS goes on. Timer 1 stops when RTS goes off. You are not measuring the time between trigger events.

```
Block 1:        Start Timer 1
                When RTS goes  On
                     then goto Block 2
Block 2:        Stop Timer 1
                When CTS goes  On
                     then goto Block ....
```

CORRECT WAY TO MEASURE TIME

This example shows the correct way to measure the time interval between two trigger conditions. The starting and stopping of the timer is entirely dependent upon the occurrence of the two trigger conditions.

```
Block 1:    When Lead RTS goes  On
                then goto Block 2
Block 2:    Start Timer 1
Block 3:    When Lead CTS goes  On
                then goto Block 4
Block 4:    Stop Timer 1
```

USING TIMERS IN SIMULATE

These simulate examples illustrate the same principles described above.

This example is NOT correct. It is not known when Timer 1 will start. Timing measurements should always reference a trigger

```
Block 1:        Set Lead RTS  On
Block 2:        Start Timer 1
                When Lead CTS goes On
                    Then goto Block 3
Block 3:        Stop Timer 1
```

Simulate DTE. This example is correct. Timer 1 does not start or stop until the preceding <When Trig> statement is satisfied

```
Block 1:        Set Lead RTS  On
                When Lead RTS goes On
                    then goto Block 2
Block 2:        Start Timer 1
                When Lead CTS goes On
                    then goto Block 3
Block 3:        Stop Timer 1
```

Counting Events -- INC CTR

Use the <Inc Ctr> statement for counting events. The HP 4951C has five counters, which let you count five different events simultaneously. "Events" may be characters or character strings occurring on the line, lead changes, timer changes, counter changes, or program loops; almost any action the analyzer performs can be counted. To use the counters effectively, place the increment counter statement directly after the event of interest.

Maximum Count. Each counter counts to 9,999 and then starts over from zero. By having one counter increment whenever a second counter overflows, you can count up to nearly 10,000 times 10,000. You can cascade all five counters this way.

Reset. Counters and timers are always reset to zero at the beginning of a run; i.e., when you press <Run>. Counters or timers may also be reset under program control with the <Reset> statement. When they are reset during a program, they go to zero and do not restart unless you start them again.

Examples. The first example below counts the number of parity errors on the DTE line.

```
Block 1:      When  Error Parity on DTE
                  then goto Block 2
Block 2:      Increment Counter 1
                  and then goto Block 1
```

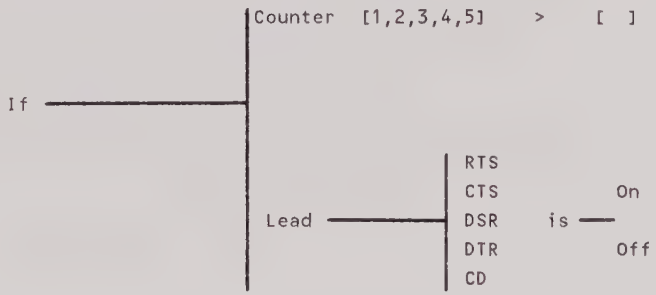
The second example counts the number of times RTS goes on.

Note: You must have a character oriented protocol selected in the setup menu for this example.

```
Block 1:      When Lead RTS goes On
                  then goto Block 2
Block 2:      Increment Counter 2
                  and then goto Block 1
```

Testing Status -- IF

The <If> statement tests current counter or lead status. For leads, "current" means at the time of the last trigger. Counters are independent of line status.



HOW <IF> AND <WHEN TRIG> ARE DIFFERENT

Only <When Trig> defines a trigger. "When" causes the analyzer to look for events or transitions starting from the point where the last trigger was satisfied. <If> is concerned only with current states. Unlike <If>, program flow stops until <When Trig> is satisfied.

COMBINING <IF> STATEMENTS

Just as with <When Trig> statements, <If> statements within the same block are "ORed". The first statement satisfied controls the branch.

USING <IF> WITH COUNTERS

Counters run independently of line status. Therefore, an <If> statement testing counter status need not be preceded by a <When Trig> trigger statement.

This example counts the number of times RTS goes on. When RTS goes on 100 times, the test stops.

```
Block 1:    When  RTS goes On
                then goto Block 2
Block 2:    Increment Counter 1
            If Counter 1  >  99
                then goto Block 4
Block 3:    Goto Block 1
Block 4:    Stop Tests
```

USING <IF> WITH LEADS

Line status can only be checked by a <When Trig> trigger statement. Therefore, an <If> statement testing a lead condition always refers to the line status at the time of the last trigger.

In this example, Block 2 tests CTS when the <When Trig> statement in Block 1 is satisfied.

```
Block 1:    When  Lead RTS goes On
                then goto Block 2
Block 2:    If  Lead CTS is On
                then goto Block 4
```

Marking Trigger Events

By using the Start, Stop, Beep, and Highlight commands, you can have the HP 4951C notify you when it has found a particular event (Events are defined by triggers.). As discussed previously in this chapter, timers and lead status must be tied to a preceding <When Trig> statement. The same is true of Start, Stop, Beep and Highlight. For example, whenever you "Start" an action, always provide a reference to some line event with a preceding <When Trig> statement.

The <Wait> statement should not be used with any of these commands. Use <Wait> only with <Send> and <Set Lead> to delay output.

<START> AND <STOP>

The <Start> and <Stop> statements can be used to filter events of interest: you let the HP 4951C do the watching for you. Define an event of interest in a preceding <When Trig> statement, and then "start" or "stop" the display, disc, or timers when that event occurs. Of course, no data is actually lost; line data is continuously filling the buffer.

Stop Display

The <Stop Display> statement freezes the display after the occurrence of some trigger event. That trigger event and the immediately preceding data, are displayed on the screen. Note that the run is not stopped: the buffer is continually being filled with new data. To stop the run after the event, use <Stop Tests>.

Start & Stop Disc

The disc can be started and stopped only once during a program.

Start & Stop Timer

Timers measure intervals between trigger events. Always precede <Start> and <Stop> timer statements with a <When Trig> statement defining the event. Otherwise, your time measurements may not be accurate.

Stop Tests

The <Stop Tests> statement causes the analyzer to halt. No new data is loaded into the buffer or displayed, the disc stops, and any active timers stop. You can use this statement within a program to have the analyzer immediately stop upon finding some event.

Examples of Start and Stop

The first example below stops the run if there is a Negative Acknowledgment on the DTE line. Note that you enter the "NAK" by pressing the CNTL and "U" keys at the same time as indicated by the keycap.

```
Block 1:        When  DTE  NAK
                    then goto Block 2
Block 2:        Stop Tests
```

The second example freezes the display if there is a Frame Check Sequence error on the the DTE line.

```
Block 1:        When Error  FCS on DTE
                    then goto Block 2
Block 2:        Stop Display
```

BEEP

The <Beep> statement provides an audible sound for some specified condition. You can have the analyzer beep anytime, and as often as desired.

HIGHLIGHT

Use <Highlight> after a <When Trig> statement to mark trigger events in memory: characters, errors, lead or timer transitions. Highlighted characters appear in half-bright video both during run-time and when looking at the buffer in <Exam Data> mode. Lead and timer transitions appear in the DCE line in <Exam Data> if you are not using the <Data & State> display. The HP 4951C "remembers" only the last 64 highlights in the buffer. Only the last character of a character string is highlighted. Highlight examples are shown in Figure 6-3. Note that the clock timeout highlight is denoted by a small clock face symbol.

Examples of Highlight and Beep

This example highlights the "z" in the "xyz" string whenever it occurs on the DCE line.

```
Block 1:      When DCE  xyz
                  then goto Block 2
Block 2:      Highlight
                  then goto Block 1
```

This example causes a continuous beep whenever the string "abc" occurs on the DTE line.

```
Block 1:      When DTE  abc
                  then goto Block 2
Block 2:      Beep
                  and then goto Block 1
```

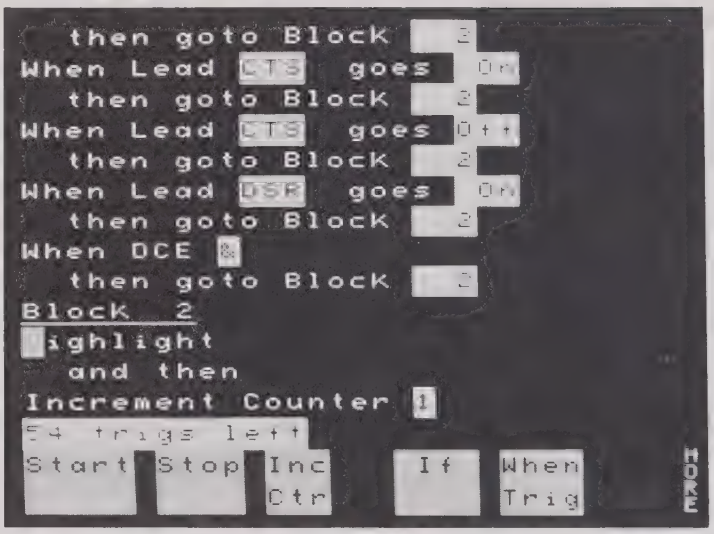


Figure 6-3. Highlights in the Buffer (Examine Data Menu)

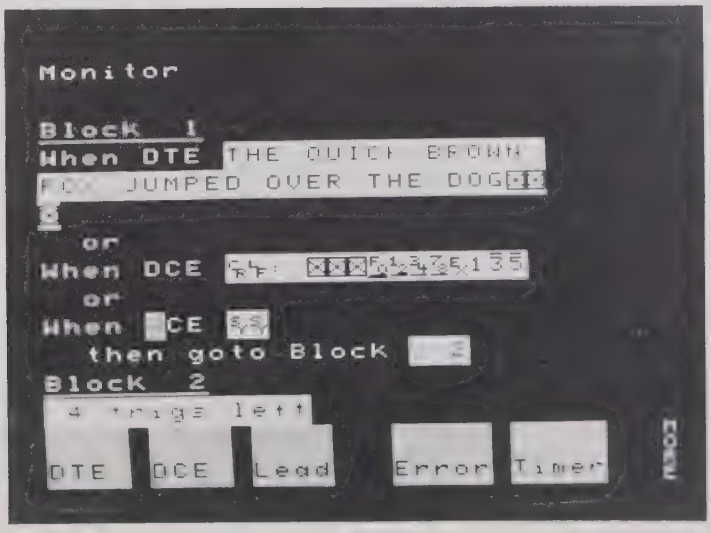
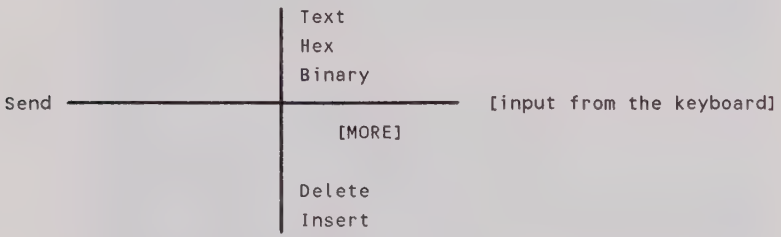


Figure 6-4. Portion of Program Producing the Display in Figure 6-3.

Transmitting Characters -- SEND

(Simulate only)

Using <Send>, you can simulate a DTE or DCE by sending any bit or character sequence in any of the codes supported by the HP 4951C. Maximum length for each string is 255 characters.



HANDSHAKING REQUIREMENTS ON THE INTERFACE

Determine which interface leads must be set on or off before sending data. Otherwise, the receiving equipment may not accept the data.

The HP 4951C does not need to set control leads before sending data. However, the receiving equipment may require control signals before accepting the data you are sending. See page 6-27 for discussion of the <Set Lead> statement.

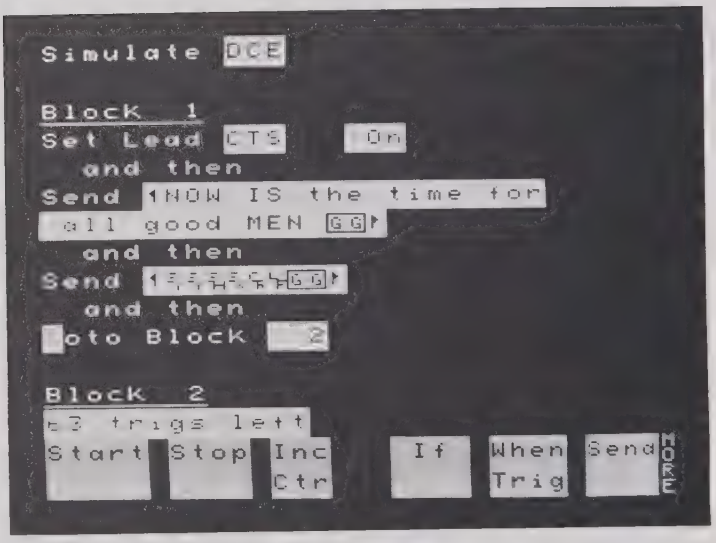


Figure 6-5. Sending Characters in Simulate

SELECTING SEND CHARACTERS

Use the <Text> softkey for keyboard characters. The SHIFT key accesses lower-case characters and the CNTL key accesses control characters. You can see the binary or hex value by positioning the cursor over that character and pressing <Hex> or <Binary>.

In character oriented protocols you must explicitly enter sync characters such as $^{S}_{Y}$ $^{S}_{Y}$. Otherwise, the receiving device does not recognize the message.

When a Character is not on the Keyboard

EBCDIC and some other data codes have control characters which are not on the keyboard. Go to the data code tables in Appendix B to find the hexadecimal equivalent. Press the <Hex> or <Binary> softkey and enter that character from the keyboard.

Binary and Hex Characters

Use the <Hex> or <Binary> softkeys to enter hexadecimal characters or binary strings. Two numbers occupy each hex character position, requiring two keyboard entries. When you press <Binary>, eight binary bits are displayed, this lets you enter a 1 or 0 in any BIT position from the softkeys. Once you move the cursor out of the binary string, it collapses to its hex equivalent.

Editing Strings

Use the <Delete> and <Insert> softkeys to edit a string. Press MORE to access these softkeys when the cursor is positioned in the string.

Sending Idles

During simulation, the HP 4951C continuously sends idles when not sending data. This is also true when using <Wait> to delay output. You can explicitly enter idles within text when simulating, but otherwise they are not stored in the buffer during normal monitoring or simulating.

Block Check Characters (BCC)

In character oriented protocols, the HP 4951C automatically appends the correct block check characters to <Send> strings. You can see these characters at run-time or in the buffer after a run. In Char Async/Sync setup you can select the characters on which error checking is to start and stop. **Start on** character starts error checking on the character following the designated character. **Stop on** character includes the designated character in the error check.

Flags and Frame Check Characters

Flags and frame check sequence (FCS) characters are automatically added whenever a bit oriented protocol (HDLC, SDLC, X.25) is selected in the Setup Menu. The HP 4951C does not show you the actual frame check character. For received data, GG, BB, or AA are displayed to indicate "good FCS", "bad FCS", or "abort". For Send strings, good FCS characters (GG) are automatically selected; but you may choose Bad FCS (BB) characters or Abort (AA) characters, either by moving the cursor to the frame check characters, or by pressing MORE and then the <End Frame> softkey. Flags and frame check characters disappear if you change the Setup to a character oriented protocol and again move the cursor into the string.

Parity Bits

In <Text> mode the current setup determines the parity bit. In <Hex> or <Binary> mode the current setup also determines the setup for 8-bit data codes (e.g., ASCII 8, EBCDIC). For data codes less than 8-bits (e.g., ASCII 7, Baudot), the parity bit is determined by the hex or binary entry.

For example, assume the setup is ASCII 7 with odd parity. In the <Text> mode, if you enter an "E" in the send string, the transmitted binary code will be 01000101. The parity is 0 (left-most bit). To change the parity bit to 1, use <Binary> or <Hex> and enter 11000101 or C5.

NOTE: The run-time and Examine Data displays ignore the parity bit on transmitted data. In the above example, the run-time and examine data displays show an "E" even when you send C5. However, parity errors are detected on received data. When receiving a C5 with odd parity, the C5 appears as a blinking "E" in both displays and the parity bit indicated in the examine data menu is 1.

Zero Bit Insertion

In bit oriented protocols, the HP 4951C automatically inserts a 0 after five consecutive 1's before transmitting non-flag characters (invisible to the user). When receiving, it automatically removes any 0 bits inserted by the transmitter. This is not true in Char Async/Sync setup.

Changing the Setup After Typing the String

If the data code or protocol are changed in the Setup Menu after typing a character string, you must retype the string. Characters in one code may not have the same meaning in another code. When you move the cursor to that character the HP 4951C shows "?" if it cannot find the hex or text equivalent in the new code. The binary value of the character can always be viewed by pressing the <binary> softkey.

USING TIMERS WITH <SEND>

As always, timers measure intervals between trigger events. Each line event is "time stamped" as it is placed in the buffer. Timers are always referenced to the last preceding <When Trig> trigger statement.

As shown in the following examples, sync characters must be explicitly entered in character oriented protocols. Otherwise, the receiver does not accept the message.

The next example is the correct way to measure the time it takes to send the string. The timer is activated by the preceding <When Trig> statement.

```
Block 1:    Send  SY SY SX abcdefghijk EX
                  and then goto Block 2
Block 2:    When  DTE  a
                  then goto Block 3
Block 3:    Start Timer 1
            When  DTE  k
                  then goto Block4
Block 4:    Stop Timer 1
```

The next example is incorrect because the timer is not tied to a <When Trig> trigger statement. You can not measure the time it takes to send a string.

```
Block 1:    Start Timer 1
Block 2:    Send  SY SY SX abcdefghijk EX
                  and then
            Stop Timer 1
```

Controlling Interface Leads -- SET LEAD

(Simulate only)

In Simulate Mode, <Set Lead> turns on or off one of the RS-232C/V.24 or RS-449 leads. The HP 4951C always knows which pod is attached and displays the correct softkeys. With a RS-232C/V.24 interface, a lead is "on" when the voltage is high; it is "off" when the voltage is low. When simulating a DTE, you cannot control DCE leads, and vice versa; only the appropriate lead softkeys are displayed, as shown below (* indicates RS 449-leads). See Chapter 15 for more information.

	DTE		DCE
Set Lead	| RTS (*RS) | DTR (*TR)	Set Lead	| CTS (*CS) | DSR (*DM) | CD (*RR)

LEAD STATUS DURING SIMULATION

Determine which interface leads must be set on or off before sending data. Otherwise, the receiving equipment may not accept the data.

The HP 4951C must be programmed to control the leads in the simulate mode (this is the only time the HP 4951C controls the interface leads). At the beginning of a simulation run, the HP 4951C sets all the interface leads listed above off. You must turn these leads on with the <Set Lead> statement in order to do handshaking with a receiving device.

LEAD STATUS WHEN NOT SIMULATING

Lead status is independent of the HP 4951C except when it is simulating. Remember this when you use <If Lead> statement in a monitor program.

SET LEAD EXAMPLES

Because the HP 4951C always sets all five leads (DTR, RTS, DSR, CTS, CD) off at the beginning of the simulation run, <Set Lead> statements are needed to turn the appropriate leads back on before sending data. If this is not done, the receiving device might not accept data from the HP 4951C. You must know the handshaking requirements on your system in order to simulate correctly.

```
Simulate DTE

Block 1:        Set Lead  DTR  On
                    and then goto Block 2
Block 2:        Wait 1000
                    and then
                Set Lead  RTS  On
Block 3:        When Lead  CTS goes On
                    then goto Block 4
Block 4:        Send  abcd
                    and then
                Set Lead  RTS  Off

Simulate DCE

Block 1:        When Lead  RTS goes On
                    then goto Block 2
Block 2:        Wait 100
                    and then
                Set Lead  CTS  On
                    and then
                Set Lead  CD  On
                    and then
                Send  abcd
```

Delaying Output -- WAIT
(Simulate only)

The <Wait> statement controls output only. Use <Wait> only with <Send> and <Set Lead> statements. <Wait> has no effect on program flow or timers.

DELAYING STRINGS OR LEADS

The <Wait> command can be set in 1 millisecond increments to cause delays of up to 65,535 milliseconds. In combination with counters, very long delays can be set up.

The following example repeatedly sends a string of numbers and then waits 50 milliseconds.

```
Block 1:      Send 1234567
                 and then
              Wait 50 msec
                 and then goto Block 1
```

Error Messages

Max Length. This message appears if you attempt to specify more than 255 characters in a single string.

Max Strings. Appears if the Monitor and Simulate Menus combined contain strings which have a total of more than 2000 characters.

Menu Full. Appears if the Monitor and Simulate Menus combined contain more than 143 steps.

Invalid Mon/Sim Menu. This may occur if you enter "When DTE/DCE" without completing the trigger branching instruction.

Status Messages (Current Mode of Entering Data)

Text. Enter a single keyboard character.

Hex. Enter two digits for each hex character.

Binary. Enter eight bits from softkeys. If the Setup data code is less than eight bits, the most significant bits are ignored.

End Frame. Enter the FCS character (good, bad, abort, don't care).

7

The Run Menu

Except in Auto Configure, where the HP 4951C automatically goes into the run mode, use the Run Menu to execute all tests. After pressing <Run Menu>, the following softkey choices appear.

Monitor Line	Monitor Buffer	Sim-ulate	BERT

Monitoring On-Line

For a detailed description of monitoring on-line, see Chapters 2 and 6.

1. **Hookup**

   Connect the HP 4951C to the line to be monitored. See Chapter 2.

2. **Setup**

   Use Auto Configure, or the Setup Menus. See Chapters 4 and 5.

3. **Program the Monitor Menu**

   This step is optional. Go to the Monitor Menu and program any measurements you want the analyzer to make. See Chapter 6.

4. **Run Menu**

   In the Run Menu press <Monitor Line>. The HP 4951C displays the line data. Use the Setup Menus to change the display format.

Monitoring From Buffer

Running from Buffer is almost the same as running on-line.

1. **Hookup**

   The HP 4951C need not be connected to the pod to monitor from buffer.

2. **Load the Buffer**

   Load the buffer with data, either from the disc, or by running on-line. With the nonvolatile memory, previously loaded data can be used.

3. **Setup**

   Use the Setup Menus. With the nonvolatile memory, previous setups are saved and can be used.

4. **Program the Monitor Menu**

   This step is optional: you may go right to the Run Menu. But one of the advantages of monitoring from buffer is that you can program the HP 4951C to run measurements over and over on the data in the nonvolatile buffer.

5. **Run Menu**

   In the Run Menu press <Monitor Buffer>. The HP 4951C begins displaying buffer data and running any measurements you may have setup in the Monitor Menu.

Running Simulation

1. **Hookup**

   Substitute the HP 4951C for the DTE or DCE. See Chapter 2.

2. **Setup**

   Use the Setup Menus. See Chapter 5.

3. **Program the Simulate Menu**

   In the Simulate Menu, select either DTE or DCE. Using the softkeys, select the operations (e.g., Sending or Setting Leads) you want the HP 4951C to simulate. See Chapter 6.

4. **Run Menu**

   In the Run Menu press <Simulate>. To change the display format, go back to the Setup Menus.

Running BERT

Hook up the HP 4951C as a DTE. After the appropriate selections in the BERT menu, perform the BERT test by going to the Run Menu and pressing <BERT>. See Chapters 2 and 9.

Run-Time Softkeys

Softkeys and messages shown at the bottom of the display during run-time are:

```
Hex        Stop Disp        Block = n        Summary
```

Hex/Text. Pressing <Hex> converts all subsequent displayed data to hex format. The softkey label then changes to <Text> for changing the display back to the current data code.

Stop Display/Start Display. The <Stop Display> softkey alternates with <Start Display>. The <Stop Display> softkey freezes the display, and <Start Display> causes the most recent incoming data to be displayed. These do not affect the run, but the continuity of the run-time display may be lost.

Block = n. Message indicating which 2 Kbyte block of memory (1 to 16) is being displayed. When memory wraparound occurs, the next 2 Kbyte block to be loaded becomes Block 1. When viewing the buffer after run-time with Examine Data, the oldest data becomes Block 1. In Examine Data, block numbers may go as high as 128 if the buffer data has been loaded from disc.

Summary/Data Display. These alternate to show either data or the Setup Summary. Press <Summary> at anytime, without affecting the run, to review the current setup and observe the counters and timers (see Figure 7-1). The summary tracks the current Setup Menu. Timers are updated whenever a trigger is found. Counters are updated every half second. Counters automatically roll over at 9999 to 0. Press <Data> to return to the data display.

Run-Time Messages

Running. Message indicating data is being processed.

No Pod Attached. An interface pod must be attached in order to run BERT, Auto Configure, Simulation, and Monitor on-line. No pod is necessary to Monitor from Buffer.

Buffer Overflow. Data has filled the buffer (16 blocks) and will begin to overwrite data (in block 1) that has not yet been processed. This can occur when storing data directly from the line to disc, or when incoming speed is higher than specified.

Receiver Overrun. The hardware capability to process serial input is being exceeded. Typically, this may occur at line speeds greater than 30 Kbps per second in character oriented protocols, and speeds greater than 64 Kbps per second in bit oriented protocols.

Invalid Monitor/Simulate Menu. This occurs because of incomplete <When> or <If> statements. For example, if you do not finish the statement "When DTE".

```
Protocol          HDLC
Ext Addr  OFF                 Ext Ctrl        Off
Code        ASCII-8           Err chk         CCITT
Parity            None

Mode              Sync        DTEclock        DCE
                              Bits/sec         9600
                              Dispmode        F & P

Counter 1 =       11          Timer 1 =        0
Counter 2 =        0          Timer 2 =       83
Counter 3 =        0          Timer 3 =        0
Counter 4 =        0          Timer 4 =        0
Counter 5 =        0          Timer 5 =        0
                                                Data
                                                Disp
```

Figure 7-1. The Setup Summary Display

Displaying Data

Five display formats are available. Use the Setup Menus to change the display format. Figures 7-2 to 7-6 show examples of each format.

DTE	DTE data only. Displayed in regular video.
DCE	DCE data only, Displayed in inverse video.
Two Line	DTE over DCE. DCE data is displayed in inverse video.
Data & State	DTE over DCE data, and timing diagrams of four interface leads.
Frame & Packet	Decodes bit oriented frames. Decodes X.25 packets in the Examine Data Menu (see Chapter 8 for a definition of terms).

FULL DUPLEX AND HALF DUPLEX DATA

See Figures 7-7 and 7-8 for examples of full duplex and half duplex data. On half duplex data, the HP 4951C displays complete DTE messages alternating with complete DCE messages. On full duplex data, the HP 4951C displays the individual characters according to the timing order in which they are received.

BLINKING CHARACTERS

Blinking characters indicate failed error checks: BCC, FCS, parity, or framing errors resulting from incorrect setup or loss of synchronization. See Chapter 8.

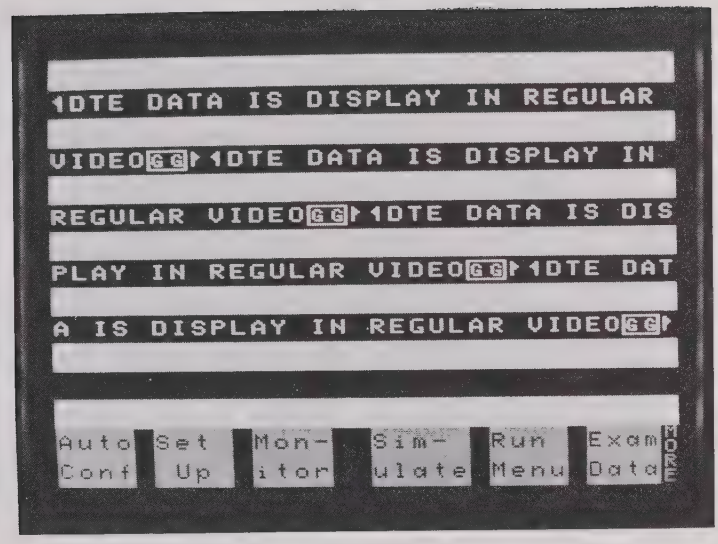


Figure 7-2. DTE Display Format

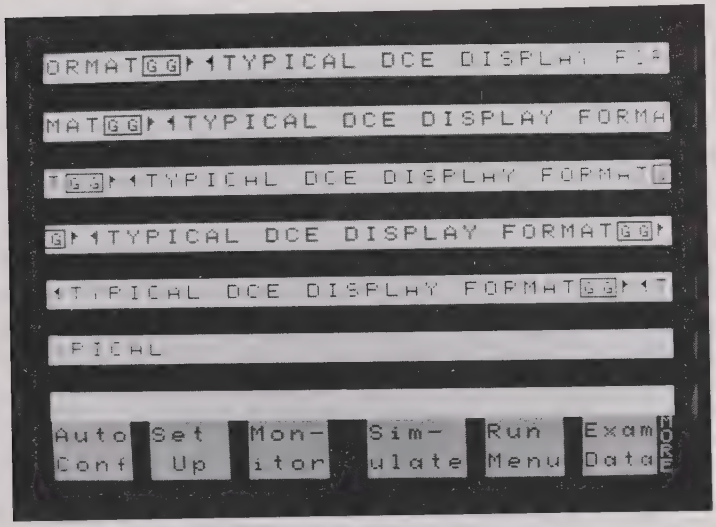


Figure 7-3. DCE Display Format

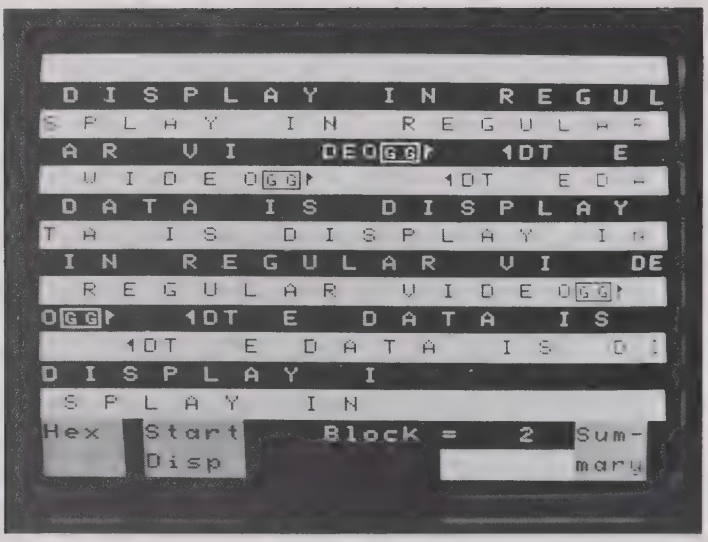


Figure 7-4. Two Line Display Format

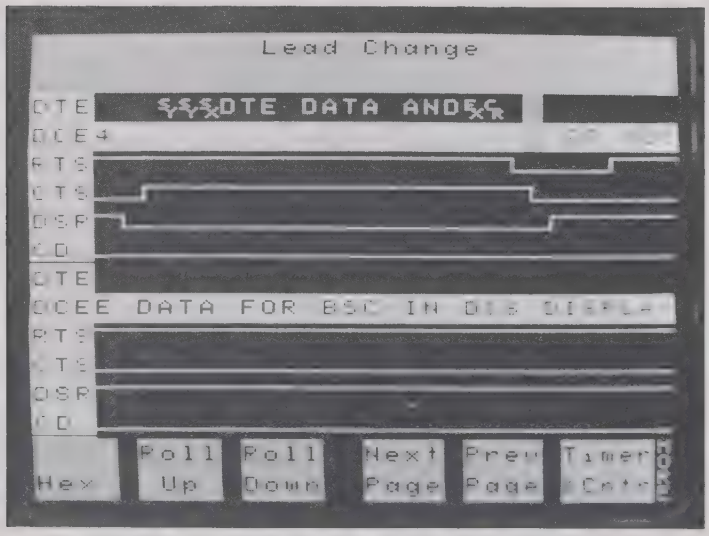


Figure 7-5. Data & State Display Format

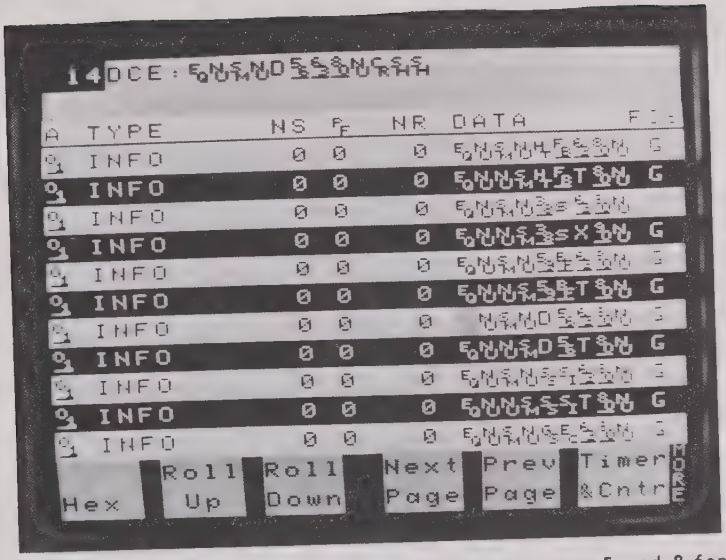


Figure 7-6. Frame & Packet Display Format (See Chapters 5 and 8 for definitions)

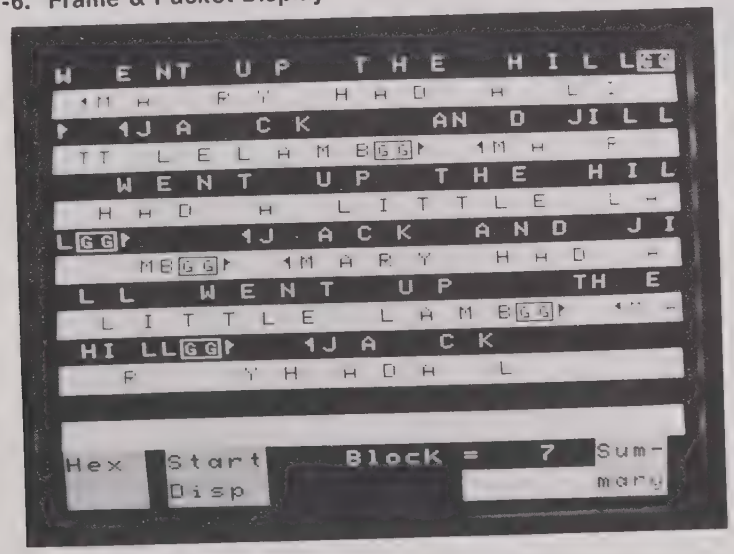


Figure 7-7. How Full Duplex Data Looks (See page 7-6)

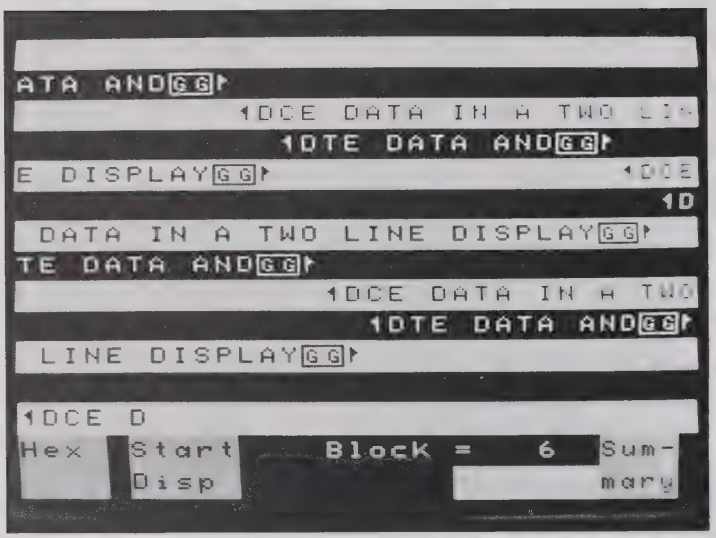


Figure 7-8. How Half Duplex Data Looks (See page 7-6)

8

The Examine Data Menu

Viewing the Buffer

Press <Exam Data> on the Top Level Menu to look at the buffer after run-time. Note how this differs from Monitoring On-line, Monitoring From Buffer, or Simulating. In all these, you are looking at the buffer during run-time. You can stop the display, but you cannot go backward. The Examine Data Menu lets you scroll through the entire 32 Kbyte buffer.

WHAT IS STORED IN THE BUFFER

Most line activity is stored in the buffer. This is what makes it possible for the HP 4951C to post-process data from the buffer). The following items are stored:

1. DTE and DCE characters.
2. Lead changes on the five interface leads. Select Data & State display format or use the highlight feature in the Monitor and Simulate Menus.
3. Errors, such as parity, BCC, and FCS.
4. Frame markers and packet markers.
5. Time marks and lead status.

HOW TO LOAD THE BUFFER

The buffer is continually being loaded with data when monitoring on-line or simulating. The buffer can also be loaded from disc.

Uses for the Examine Data Menu

Viewing Timers and Counters after a run. The Examine Data Menu lets you look at the final state of the timers and counters after a run. The timers and counters are only reset if (1) another run is started, (2) <Reset> is pressed, or (3) before loading data from disc.

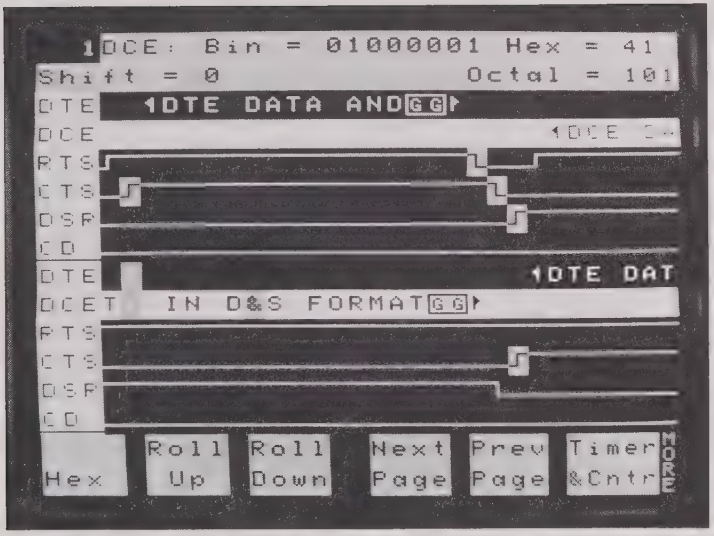
Viewing the Entire Buffer. During run time you can stop the display, but you can't go back and look at what you've missed. The Examine Data Menu lets you go back after a run and scroll through the buffer.

Bit Shifting. If the framing is off because the sync characters are unknown, use the bit shift softkey in the Examine Data Menu to realign the bits until the data becomes meaningful. See page 8-9.

Decoding Characters. Move the cursor to any character and observe the binary, hex, and octal equivalents at the top of the display. You can also see the parity bit for any character.

Decoding Packets. In X.25 setup and Frame & Packet display format, the HP 4951C decodes packet headers simultaneously with control field information in the Examine Data Menu. See page 8-6 for a description.

Decoding High Level Protocols. If the data contains other higher level protocol information (e.g., ISO levels 4-7, or SNA), the relevant fields can be read from the hex/octal/binary decoding at the top of the display.




```
Hex     Roll    Roll    Next    Prev    Timer
        Up      Down    Page    Page    &Cntr

MORE

Spec.   Next                            Bit
Block   Hilit                           Shift
```

Figure 8-1. Buffer Display in Examine Data Menu (Data & State Display Format)

Softkeys

Hex/Text. Displays buffer data in either the code selected in the Setup Menu, or in hexadecimal.

Roll Up/Roll Down. Lets you move the displayed buffer data up or down one line at a time.

Next Page/Prev Page. Moves from one display-full of data to another. A page is one full display of information.

Timers & Counters. You can at any time look at a summary of the Setup parameters, as well as the status of the timers and counters at the end of the last run.

Specify Block. For specifying a particular two Kbyte block. The block number indicates the first character's position in the buffer. Some buffer information, like time marks, is not displayed, so <Next Page> may cause the block number to jump by several numbers. Buffer data loaded from disc may have block numbers as high as 308.

Next Highlight. The <Highlight> softkey in the Monitor or Simulate Menus lets you mark trigger events. This softkey lets you move to the next highlighted event.

Next Segmt/Prev Segmt. With this feature you can examine the disc like the buffer. These softkeys load either the next or the previous 16 Kbytes of data from disc into the buffer for observation. This choice appears only when you have loaded a disc file.

Bit Shift. Shifts framing of the displayed characters one bit at a time. Use this softkey to find the correct framing of unknown protocols (see page 8-9). The parity bit is not shifted. This choice appears only in character oriented setups.

Displaying Data

The same five display formats available during run-time are available in examine data. See Figures 7-2 to 7-6.

DTE	DTE data only. Displayed in regular video.
DCE	DCE data only, Displayed in inverse video.
Two Line	DTE over DCE. DCE data is displayed in inverse video.
Data & State	DTE over DCE data, and timing diagrams of four interface leads.
Frame & Packet	Decodes bit oriented frames. In the Examine Data Menu only, decodes X.25 packets. See page 8-6.

HOW SETUP AFFECTS DISPLAY

In some display formats you may not be able to observe the buffer data. For example, with frame & packet format, you cannot see BSC data. Data & State format always shows any data in the buffer, even when it consists only of lead transitions.

BLINKING CHARACTERS

Blinking characters indicate failed error checks: BCC, FCS, parity, or framing errors resulting from incorrect setup or loss of synchronization. See page 8-8.

X.25 in Frame & Packet Display Format

X.25 looks the same as HDLC or SDLC when running in the frame and packet display format. After capturing data, however, the Examine Data Menu shows both frame decoding and packet decoding. As shown on the next page, packet information at the cursor location is decoded at the top of the display. The following packet information is displayed. See Appendix C for more details.

Q-Bit	Qualifier Bit.
D-Bit	Delivery Confirmation Bit.
MOD	Modulo 8 or 128.
LCN	Logical Channel Number.
TYPE	Type of packet. Displayed below DTC or DCE.
P(S)	Packet Send Sequence Number.
M-Bit	More Data Mark.
P(R)	Packet Receive Sequence Number.
Data	Displays the first five characters of the data field.

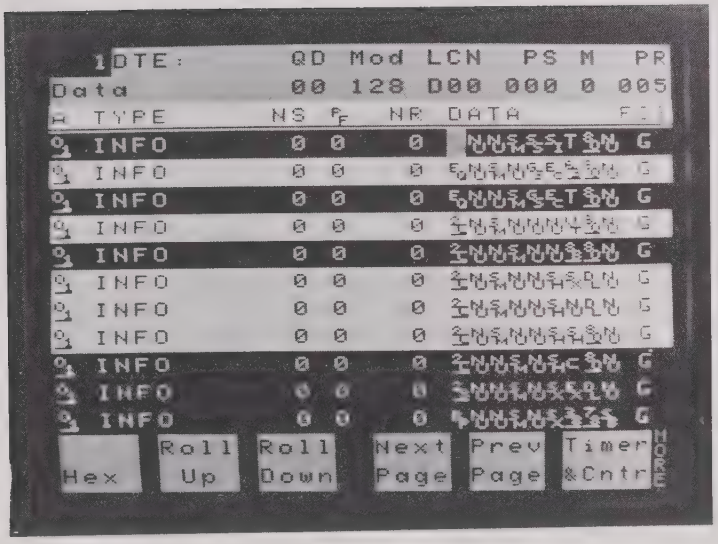


Figure 8-2. Decoding X.25 Packets with Frame & Packet Format

Finding Unknown Protocols

Use the Examine Data Menu in conjunction with the Char Asyn/Syn Menu to determine the parameters of unknown protocols.

Use Auto Configure as a Starting Point

Use Auto Configure to find at least some of the parameters and give you a starting point.

Set up the Char Async/Sync Menu

Set up the Char Asyn/Syn Menu to capture all the data on the line, including idles.

1. If you know the data code, **Sync on** idles. Otherwise, sync on FF or 00. Most character oriented protocols idle in FF. Some IPARS circuits idle in 00.

2. **Drop sync** 0 **chrs after** none. Now you never drop sync and thus take in all the data.

3. If you do not know the data code, initially use a data code with no parity of the same character frame size as was found by Auto Configure. See page 8-10.

Use the Examine Data Menu

Monitor the line to capture some data in the buffer.

1. In the Examine Data Menu, try bit shifting. If the data still does not make sense, go back to the Setup Menu and try another data code with no parity of the same character frame size. Because the HP 4951C does not shift through the parity bit, select a data code with no parity (see page 8-10).

2. Try data codes of a different size.

3. When you are able to identify the idles, change the **Sync on** to the two sync characters immediately following the idles. Change **Drop sync after** to the idle character.

4. If **bit sense** is inverted or **bit order** reversed (e.g., IPARS), you may need to go back and capture some new data with these two parameters changed.

5. Parity, block check, and frame check errors are indicated by blinking characters. Character frame length is affected both by the data code and the error checking. For example, ASCII 7 with odd parity uses an 8-bit character frame, whereas ASCII 8 with odd parity uses a 9-bit frame. See page 8-10.

Data Code	No Parity	Even or Odd Parity	Ignore Parity
Hex 5 Baudot	5 bits (no parity bit)	6 bits (including parity bit)	6 bits (parity bit = 0)
Hex 6 EBCD IPARS Transcode	6 bits (no parity bit)	7 bits (including parity bit)	7 bits (parity bit = 0)
Hex 7 ASCII 7	7 bits (no parity bit)	8 bits (including parity bit)	8 bits (parity bit = 0)
Hex 8 ASCII 8 EBCDIC	8 bits (no parity bit)	9 bits (including parity bit)	9 bits (parity bit = odd)

Figure 8-3. Frame Sizes vs Data Codes

Error Messages

No data in buffer -- Use EXIT key to exit. This occurs if the buffer is empty when you go to the Examine Data Menu. Monitor On-Line, or load from the disc to fill the buffer.

No displayable data in buffer for the selected display format. This indicates that the buffer contains non-displayable data, such as lead transitions. Use Data & State display format to see the lead transitions.

Disc removed during a Read operation. When you remove the disc during a load operation, the buffer data is invalid. Use the EXIT key to exit. Try loading the data again.

Disc read error: buffer data invalid. This may be caused by a broken disc controller, or by a worn out disc. Use the EXIT key to exit. Try another disc to help isolate the problem.

End of valid data. When you scroll to the end of buffer data.

Start of valid data. When you scroll to the beginning of buffer data.

No more highlights. When you press the <Next Hilit> key and there are no more highlights.

End of disc file. When you specify a block number beyond the last block on disc.

9

Bit Error Rate Tests (BERT)

Definitions

Bit Error Rate Tests (BERT) measure digital noise: how often "highs" are changed to "lows", and vice versa

PRBS (Pseudo Random Bit Sequence). A BERT tester generates pseudo random bit sequences from a shift register of length L, where the sequence length equals $2^{\wedge L} - 1$ bits. A PRBS may be of any length, but certain pattern lengths have become standard. The HP 4951C uses PRBS lengths of 63, 511, or 2047.

Bit Error Rate. The number of bit errors divided by the number of bits received.

Blocks. Bit error rate does not give any idea of error distribution. For example, if most errors occur within a few moments of each other, it might indicate that the line was all right, but had perhaps been affected by a lightning hit or path switch. For this reason, bits are grouped in blocks for measuring block error rate.

BERT "blocks" are not to be confused with the blocks used in other HP 4951C menus.

Block Error Rate. The number of block errors divided by the number of blocks received. Whether there is one error or ten errors in a block, it is still counted as one block error.

Block Sizes. The Bell system uses a block size of 1000 bits. CCITT, the world-wide standard, uses a block size equal to the pattern size. For example, if the PRBS pattern is 511 bits, then the block size would also be 511 bits.

BERT Menu Softkeys

Press BERT on the Top Level Menu. The BERT Menu selections are shown on the next page.

Pattern. Three PRBS pattern lengths are available: 2047, 511, and 63 bits.

Block Size. Two selections are available: 1000 bits and CCITT specification. The 1000-bit block size is used in the US and CCITT is used in other countries. When CCITT is selected, block size is always the same as pattern size.

Duration. You can select the length of the test either as a time interval or as the number of bits sent. For later comparison, test durations must be the same.

Bits/Sec. Notice the Bits/Sec selections are different from the other menus.

Framing. Framing means that you send standard asynchronous characters with one start bit and two stop bits. Thus, the frame size is equal to the start and stop bits, plus an optional parity bit, plus the selected character size. To select framing, choose the size of the data character (5, 6, 7, or 8 bits). An optional parity bit may be added immediately after the data character, before the two stop bits. Each frame alternates with an idle (high) time which is the same length as the frame. If you don't want framing, press <None>.

Parity. If you select framing, three new softkey choices appear. You can select odd or even parity, or have no parity bit at all.

BERT Menu Selections

Pattern
[2047]
[511]
[63]

Block Size
[1000 bits]
[CCITT spec]

Duration

[10^4]	[10^9]
[10^5]	[5 min]
[10^6]	[10 min]
[10^7]	[15 min]
[10^8]	[Cont]

Framing
[None]
[5 bits]
[6 bits]
[7 bits]
[8 bits]

Parity
[None]
[Odd]
[Even]

Bits/sec

[19200]	[3600]	[200]
[9600]	[3200]	[134.5]
[7200]	[*2000]	[110]
[4800]	[1800]	[75]
[2400]	[600]	[50]
[1200]	[300]	[EXT]

* 2000 works only with framing

Running a BERT Test

Run Menu. After you have entered the test parameters in the BERT Menu, press <Run Menu>. In the Run Menu press <BERT>.

Data Screen. When you press <BERT> in the Run Menu, a run-time data screen continuously displays test progress. The data screen shows elapsed seconds since synchronization, number of bits and blocks sent, number of errors found, and the number of errored seconds.

Completion of a Test. When a receiving BERT tester receives all the bits required for the test, or when you press EXIT, the receiver stops the test. The transmitter continues to transmit, ensuring that the other receiver gets all needed test bits.

% Error-free Seconds. When the receiver is finished, or when you press EXIT, the % error-free seconds is computed.

Exit Key. EXIT halts reception. Press EXIT again to return to the Top Level.

Setup Summary. During a test, press <Summary> to look at the setup parameters without stopping the test. To change any of the setup parameters, stop the test by pressing EXIT twice and re-enter the BERT Menu.

Data Display Definitions

Elapsed Seconds. Elapsed time since receiver synchronization.

Errored Seconds. Tells how many of the elapsed seconds had error occurrences.

% Error-Free Seconds. Errored Seconds divided by Elapsed Seconds. Displayed at the end of the test.

Block Count. Tells how many blocks have been sent thus far in the test.

Block Errors. Tells how many blocks had at least one error. Divide block errors by block count to get Block Error Rate.

Bit Count. The number of actual data bits sent since synchronization (excluding framing, start, stop, and parity bits).

Bit Errors. Divide bit errors by bit count to get Bit Error Rate.

Inject Error. Press <Inject Error> at any time during the test. The receiver at the other end should indicate one bit error. This function can be used at the beginning of the test to check for proper hookup.

Inject 10 Errors. This is a way of sending a burst of errors. The receiver at the other end should have counted ten bit errors, one or two block errors, and one or two errored seconds.

Requirements

Sychronization and handshaking requirements must be met to properly perform accurate BERT testing and are detailed in the following paragraphs.

SYNCHRONIZATION

Unless the BERT receiver is synchronized to the transmitter at the other end, the receiver has no way of knowing whether the next bit in the received PRBS pattern is correct. You should use BERT testers equivalent to the 4925 which have the following characteristics:

(1) For unframed patterns, the speed of the clock generating the transmitter pattern must be within 1% of the clock generating the receiver pattern.

(2) With framing, the clocks should be within 5% of each other.

HANDSHAKING

For BERT testing the HP 4951C simulates a DTE. At the beginning of the test the HP 4951C sets the RTS and DTR interface leads "on". For RS-449 interfaces, it sets RS and DS on.

Error Messages

There are two possible error messages (both faults are automatically recoverable).

Out of lock -- data fault: The tester couldn't synchronize at the beginning of the test because of a wrong pattern, or the absence of data.

Out of lock -- sync loss: The tester lost synchronization during the test.

Examples

EXAMPLE 1: End-to-End Testing

Two BERT testers are connected to opposite ends of the line. Each BERT tester contains both a transmitter and a receiver, making it possible to check both send and receive channels simultaneously. The transmitter at each end is essentially a PRBS generator; the receivers are pattern checkers.

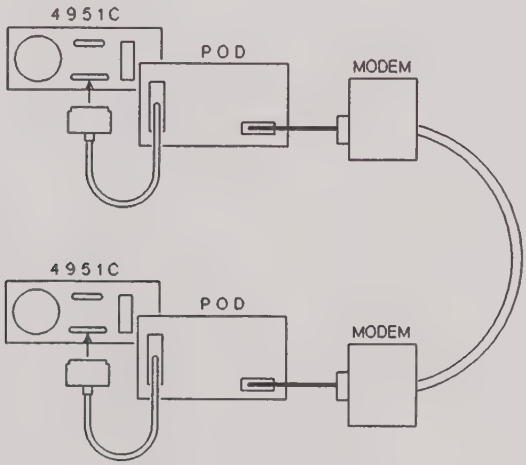


Figure 9-1. End-to-End Testing

EXAMPLE 2: Loopback Testing

If you have only one BERT tester, you can loop back at the other end. The BERT tester sends on one channel, and receive its own transmission on the other channel. Remember, if you loop back, you will be adding together the errors on both the send and receive channels: one channel may contain many more errors than the other channel.

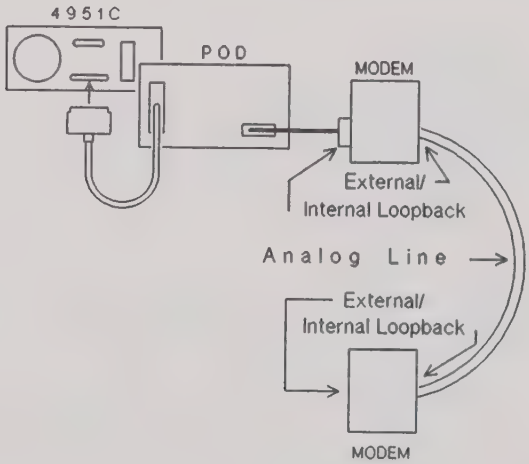


Figure 9-2. Loopback Testing

OTHER TESTS

Some BERT testers (such as the HP 4925) perform the following character error checking besides BERT tests.

Quick Brown Fox Tests

The "Quick Brown Fox" message (or any message) tests the ability of terminals to receive messages. Use the Simulate Menu to run this test. The HP 4951C also checks parity errors. See example 4 in Chapter 14.

Startup Tests

The HP 4951C does many types of start-up tests, such as RTS - CTS delay. Use the Simulate Menu. See Chapter 14.

10

The Remote Menu

Remote Operations

The HP 4951C can transmit and receive menus and buffer memory remotely to an HP 4951A/B/C, an HP 4955A, or an HP 4953A. The menus and/or buffer data must currently be in the HP 4951C memory to be available for transmission. Once transmitted, the menus or buffer data should be saved on mass storage for future use or reference (the next remote transfer could inadvertently overwrite and destroy the menu or buffer data downloaded). For remote operations, the HP 4951C must be executing in the Remote Menu. The controller must successfully execute the Slave's ID operation before remote transfers can begin.

PROCEDURE

1. Connect both slave and controller to asynchronous modems via the Remote/Printer (RS-232/V.24) connector on the rear panel. The units can also be connected without modems by using the interface pods. See page 10-7 if you are not using modems.

2. At both sites go to the Remote Menu and select one as <Controller> and the other as <Slave>.

3. Select the same Bits/sec for both slave and controller. When using an HP 4955A or HP 4953A as a controller, select the same address for slave and controller.

4. Select <Slave's I.D.> operation at the controller.

5. Press <Execute> at the slave, and then at the controller.

6. After establishing modem communication, at the controller site again <Execute> the <Slave's ID> operation. This is necessary to synchronize remote transfers.

Using the HP 4951C as a Controller

As a Controller, the HP 4951C downloads menus and data to the Slave. The HP 4951C can also receive uploaded information from the Slave.

Upload Menus. Receives setup, monitor, simulate, and run menus from the slave.

Upload Data. Receives buffer data from the slave. You must specify the correct block limits in the slave: Start Block n1, End Block n2.

Upload Appl. Receives an application program from the slave's Application Memory.

Download Menus. Transmits setup, monitor, simulate, and run menus to the slave.

Download Data. Transmits buffer data to the slave.

Download Appl. Transmits an application program from its application memory to that of the slave.

Slave Status. Requests the slave to transmit its current status.

Slave ID. Necessary to initiate and synchronize remote transfers after hookup. The slave transmits "HP 4951C".

REMOTE MENU -- CONTROLLER CONFIGURATION

Configuration Controller

Operation

[Upload Menus]
[Upload Data]
[Upload Appl]
[Slave Status]
[Slave ID]
[Download Menus]
[Download Data]
[Download Appl]

Start Blk [ ] **End Blk** [ ]

Interface [Pod] or [Remote Port]

Bits/sec

[9600] [4800]
[2400] [1200]
[600] [300]
[200]

The following status messages appear during execution.

Status

Operation executing
Operation successful
Slave rejected operation
Slave not responding

Using the HP 4951C as a Slave

A slave HP 4951C responds to any of the commands from a controller HP 4951C (See the operation list on the previous page). When in the remote menu, a slave HP 4951C transmits or receives menus, data, or application programs to the controller. Also, any error condition which occurred during the transfer can be obtained by the controller's Slave Status command.

HP 4955A AND HP 4953A CONTROLLER COMMANDS

Application programs cannot be transferred between an HP 4955A or HP 4953A and a HP 4951C. Other than this exception, an HP 4951C responds to all the commands from a Controller HP 4955A or HP 4953A (See the operation list on the previous page).

The following operations are different when an HP 4955A or HP 4953A controls a HP 4951C Slave.

Upload Timers & Counters

Upon receiving this command from an HP 4955A or HP 4953A controller, a slave HP 4951C uploads the status of its timers and counters.

Address

The HP 4955A or HP 4953A specifies an address in all controller commands. The slave address must be selected to be the same. The address does not matter in operations between two HP 4951C's.

REMOTE MENU -- SLAVE CONFIGURATION

Configuration

```
Slave
```

Slave Addr #

```
[ Use Keyboard ]     (Only HP 4955A's or HP 4953A's
                      can request an address)
```

Interface

```
[Pod] or [Remote Port]
```

Bits/sec

```
[ 9600 ]
[ 4800 ]
[ 2400 ]
[ 1200 ]
[ 600  ]
[ 300  ]
[ 200  ]
```

The following status messages appear during execution.

Status

```
Operation executing
Operation successful
Slave rejected operation
Slave not responding
```

Ending Remote Operations

To stop execution of any remote operation, press EXIT. If you press EXIT again the HP 4951C displays the following message:

To Disconnect the Remote Link,
press the HANG UP softkey,
otherwise press EXIT

Pressing EXIT returns you to the Top Level Menu. You can then go back to the Remote Menu at any time and perform any operation.

Pressing <Hang Up> turns off DTR.

If you press <Hang Up>, you must re-enter the Remote Menu and again press <Execute> at both ends of the line to raise DTR.

Handshaking Requirements

OPERATIONS WITH ASYNCHRONOUS MODEMS

NOTE: Only asynchronous modems can be used for remote transfers.

In remote operations, the HP 4951C is configured as a DTE. The following handshaking convention is used.

1. DTR is turned on when you press <Execute>. You must press <Execute> at both ends of the line. The HP 4951C then waits for DSR to go on.

2. The HP 4951C then sets RTS on and waits for CTS and CD to go on.

OPERATIONS WITHOUT MODEMS

The HP 4951C is configured as a DTE for remote operations. If two units are connected directly without modems, one unit must be configured as a DCE. For applications with no modem, use a modem eliminator cable such as the RS-232C/V.24 printer cable M/M (HP # 13242G). You may also open all the breakout switches except pin 1 on one of the pods, and jumper the following pins: 2 to 3, 4 to 8, and 5 to 6 and 20.

Slave Error Messages

Buffer Size Too Small. The controller is trying to download too much.

Start block# must = first. The controller has not specified the first block in the slave buffer. Note that the first block may not be "1" if the buffer data has been loaded from disc.

No data in requested blks. The controller has requested data from empty blocks.

Buffer empty. The slave buffer is empty.

Conversion error: menus reset. This might occur if the menus being transferred are invalid.

Menus incompatible with HP 4951C. This might occur for certain menus created by a HP 4955A or HP 4953A.

Modem handshake fails. The controller RTS, CTS handshaking has failed

Invalid Mon/Sim Menu. This can occur if you say "When DTE/DCE" and then do not specify a trigger.

Operation not valid for HP 4951C. The operation is one that only an HP 4955A can perform.

Issue ID request to enable slave. You must always <Execute> this operation immediately after establishing phone communication in order to synchronize remote transfers.

11

Mass Storage

Because of the versatile triggering capability of the HP 4951C, you can usually find a problem before using all the memory. However, the disc drive has several advantages:

1. Store data directly from the line onto disc; this increases your buffer memory to the size of the space on the disc.

2. Save all the menus and the buffer data for future reference. In the BERT Menu only the setup (not the results) is saved.

3. Use the disc like a large buffer. The HP 4951C nonvolatile buffer memory holds 32 Kbytes of data. A disc holds up to 618 Kbytes. Using the <Next Disc Segmt> and <Prev Disc Segmt> commands in the examine data menu, you can scroll through the disc.

4. Load application programs using the disc.

How to Use the Disc Drive

Always install the transportation disc in the disc drive when transporting or shipping the HP 4951C from place to place. The transportation disc helps prevent damage to the disc drive from bumps and vibration that may occur. The warranty may be voided if the transportation disc is not used during transit.

TYPE OF DISCS

The HP 4951C disc drive uses 3 1/2 inch, double-sided, double-density flexible discs. Specify part number HP 92192A to order a set of ten discs.

CARE AND HANDLING OF DISCS

Discs require a clean, dust-free environment. To avoid damaging your discs and losing information, follow these rules for handling and caring for your flexible discs.

1. Make certain the shutter (the metal guard) is closed when the disc is not in use. The shutter protects the disc from dirt, fingerprints, and scratches.

2. Use discs in a clean environment. Avoid getting smoke, dust, eraser particles, salt air, food crumbs, hair, or fingerprints on your discs. Dust and dirt particles can scratch the disc surface which may cause loss of information.

3 Keep discs stored upright in a cool, dry place. The storage temperature range for discs is 4°C to 53°C (39.2°F to 127.4°F) with a relative humidity between 8% and 90%. Heat and moisture can damage your discs.

4. To avoid losing important information, copy and backup your discs frequently.

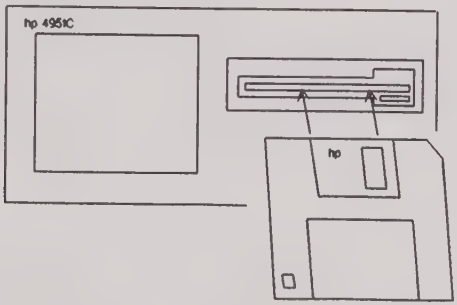
5. Do not put discs near anything that generates a magnetic field, such as a telephone, magnetic paper clip holders, or appliances with motors.

6. Do not touch the disc surface. Scratches or contaminants can reduce the life of your disc.

7. Do not try to clean the disc. The plastic jacket contains its own cleaning device. Other cleaning methods can damage the disc.

INSERTING DISCS

Hold the disc in your hand with the label side up and the metal shutter pointing towards the drive. Your fingers should be on the edge of the disc that has the paper label on it, and not the metal shutter. You do not need to open the shutter, it will open automatically in the disc drive slot. Insert the disc firmly but gently into the disc slot until the disc touches the back of the slot. Continue pressing until you hear a click and the disc is pulled down into the drive.



REMOVING A DISC

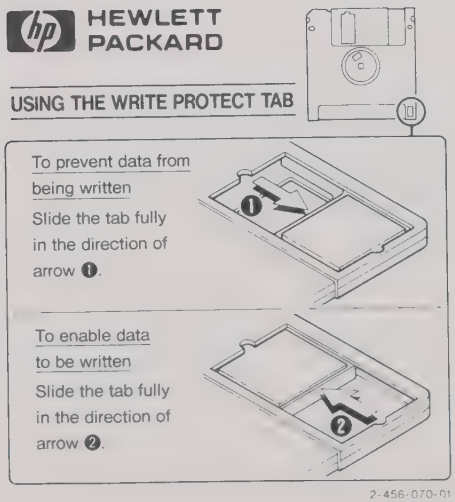
To remove a disc from the disc drive, press the gray button just below the drive. The disc will pop out part of the way. Pull the disc straight out. Check to see that the metal shutter is closed before you put the disc away.

WRITE-PROTECTING THE DISC

You can protect data on a disc to ensure that no one can inadvertently write over or delete the information on the disc. To write-protect a disc, use the following procedure.

1. Turn the disc over so you are looking at the back.
2. Place the tip of a pen in the small hole at the top of the write protect tab.
3. Slide the tab downward until it locks into place. The tab will no longer be visible from the front of the disc.

You can load (read) from the disc with the protect tab in either position.


HEWLETT
PACKARD
USING THE WRITE PROTECT TAB
To prevent data from being written
Slide the tab fully in the direction of arrow ❶.
To enable data to be written
Slide the tab fully in the direction of arrow ❷.
2-456-070-01

The Mass Store Menu

The Mass Store Menu is used for disc operations. You cannot use this menu if you have the delete disc drive option installed. The following softkeys appear when you press <Mass Store> in the Top Level Menu:

Dir	Load	Store	Del- ete	Re- cover	M_O R_E
For mat	Pack Disc		Print Appl	Re- name	M_O R_E

<DIR> - DIRECTORY

The directory (<Dir>) operation displays the disc contents giving File Name, File Type, and a Comment field. Four file types are possible:

MENU & DATA	Both buffer data and menus (setup, monitor, simulate, BERT).
MENU	Consists of menus only (setup, monitor, simulate, BERT).
DATA	Buffer data only.
APPL	Only HP 4951C application files can be loaded.

Identical file names may coexist if the file types are different. Notice that only three types of files are generated by the HP 4951C: DATA, MENU and MENU & DATA. Data type files always contain ONLY data. Menu type files contain only menus.

The Comment field is 32 characters long, with all characters displayed on the file the cursor is highlighting. All 32 are displayed on the HP 4955A or HP 4953A.

The cursor keys can be used to "scroll" through the files on the directory. The "**<---**" key acts as a **previous page** for long directories. The "**--->**" key acts as a **next page** for long directories.

```
Function                Directory
Name                    Type                    Sectors
-------------------------------------------------------------
Self_Demo               Menu                    33

X25_DECODE              Applic                  97

SNA                     Applic                  97

SNA_DATA                Menu & Data             556

Space Available =         Sectors
```

Figure 11-1. A Directory Listing

<FORMAT>

Erases the disc directory and places a new format on every track of the disc. This must always be used for blank discs. The disc is formatted utilizing a **LIF** Logical Information **F**ormat. This process of formatting should take approximately 45 seconds. The discs can be read by a HP series 200 computer but discs formatted in a series 200 are not optimized for 'run time writes' on a HP 4951C.

<LOAD>

Allows files to be loaded from the disc. File names may be entered via the keyboard or by 'scrolling' to the file name using the cursor arrow keys before pressing the <LOAD> key.

<STORE>

Allows files to be stored to the disc. File names may be entered via the keyboard or by 'scrolling' to the file name using the cursor arrow keys before pressing the <STORE> key and then modifying the name. File type must be specified and a comment is allowed to aid in file identification.

Any file marked as delete in the directory is removed by this function.

<DELETE>

Allows files to be marked for removal from the disc. File names may be entered via the keyboard **or** by 'scrolling' to the file name utilizing the cursor movement arrows **before** pressing the <Delete> key and then modifying the name. The file is marked for deletion in the directory (a **Del** in the right most columns) but actually not deleted until a <pack disc> or <store> writes over the data.

<RECOVER>

Allows files marked for removal from the disc to be 're-stored' as valid active files in the directory. Only files created on a HP 4951 disc series protocol analyzer may be recovered. Each file name must be entered via the keyboard or by 'scrolling' to the file name using the cursor arrow keys before pressing the <Recover> key and then modifying the name. This can only be done before the disc has been packed.

<PACK DISC>

Lets the directory regain use of disc space lost when files are deleted and when 'run-time' files are created.

Once pack disc has been completed there is no way for the HP 4951C to recover the purged files.

<RENAME>

Allows a file to be renamed or just change the comment associated with a file.

<PRINT APPL>

Loads the Printer Application stored in firmware into the Application ram. Any application currently loaded will be overwritten.

HOW TO LOAD DATA INTO THE BUFFER

Insert the disc into the disc slot. Press <Dir> in the Mass Store Menu to see how the file is listed on the disc. Press <Load> and cursor to the file name or type in the file name as it is listed in the catalog. Press <Execute> to load the file into the memory.

Do not perform the load operation if you want to save present menu setups.

The HP 4951C menu setups are changed by the load operation. The Setup, Monitor, Simulate, and BERT setups are all modified to the new values. You must first store these menus to another disc if you want to save them.

LOADING FILES LARGER THAN THE BUFFER

When loading a disc file that is too large for the buffer the softkeys <Next Disc Segmt> and <Prev Disc Segmt> are automatically displayed in the <Exam Data> menu. You can scroll through the rest the file by using these softkeys. These softkeys scroll through the file in 16 kbyte segments (1/2 the buffer size). Use these softkeys when running monitor programs on data files that are too large for the buffer.

AUTOAPPLIC

You can rename any **application** file as AUTOAPPLIC and have it automatically loaded when the HP 4951C is switched on. Just insert the disc with the "autoapplic" file into a 4951C and switch the power on. This should be used with caution as it conceivably could result in a menu or data being written over when the application is loaded. Always save data or menu files to disc that might possibly need to be re-used.

WHAT YOU CAN STORE ON DISC

Store both "Menus and Data", or "Menus" only. Menus saved are Setup, Monitor, Simulate, and BERT (setups only). Highlights are not saved on disc, only data and timing information.

HOW TO STORE TO DISC

Insert a disc and format the disc if it is blank. Press <Store>, enter the file name, the file type, and an optional comment; then press <Execute>. If the disc has insufficient room for a file, "Disc Full" is displayed.

STORING DIRECTLY FROM THE LINE

To directly store to disc while monitoring on line, use <Start disc> and <Stop disc> instructions in the Monitor and Simulate menus.

You can only start and stop the disc once by program control.

A file can fill the disc, after which the disc stops, and the message "Disc Full" is displayed. The disc can typically keep up at line bit rates of 9600 bps full duplex and 19.2 kbps half duplex. The disc is able to keep up at higher line bit rates if line utilization (percentage of data to idles) is low. If the disc cannot keep up, "Buffer Overflow" is displayed.

12

Reset and Self Test

The Reset Softkey

The <Reset> softkey lets you clear the memory and go back to default entries in the Setup, Monitor, and Simulate Menus.

WHEN SETUPS AND BUFFER ARE NOT SAVED

Because the HP 4951C has a battery powered back-up memory, menu setups and buffer memory data are saved after turn off. The menus saved are: Setup, Monitor, and Simulate. However, setups and buffer data cannot be guaranteed in the following cases:

1. The instrument was not in the Top Level Menu when it was turned off.

2. The battery has completely run down. This should never happen unless the instrument has been stored for more than a week in a very hot environment (or six months at room temperature).

In these cases the following message appears when you go to the monitor, simulate, or setup menus.

MENUS CORRUPT; MENUS HAVE BEEN
RESET TO THE DEFAULT CONDITION

The analyzer has been reset automatically: the buffer has been cleared, and setups return to their default values. Always press EXIT and go to the Top Level Menu before turning the instrument off.

Setup Menu Defaults

The following tables list default entries for the five Setup Menus: HDLC, SDLC, X.25, BSC, and Char Async/Sync. Whenever you press <Reset> on the Top Level Menu, these entries appear in each menu. Otherwise, the entries are whatever you had selected before you turned the power off.

HDLC PROTOCOL	SDLC PROTOCOL	X.25 PROTOCOL
External Address Off		
External Control Off		
Code ASCII 8	Code ASCII 8	Code ASCII 8
	Mode Sync	
DTE clock DCE	DTE clock DCE	DTE clock DCE
Bits/sec 9600	Bits/sec 9600	Bits/sec 9600
Display mode Data & State	Display mode Data & State	Display mode Data & State

BSC PROTOCOL	CHAR ASYNC/SYNC
	Bit order LSB 1st Bit sense Norm
Code ASCII 7	Code ASCII 7
Error check LRC	Error check LRC
	Parity None
	Transparent text char None
Sync on 16 16	Mode Sync Sync on 32 32 Drop sync 10 characters after 2D 2D 37 3D 70 7F FF
DTE clock DCE Bits/sec 9600	DTE clock DCE Bits/sec 9600
Display mode Data & State	Display mode Data & State
Suppress None	Suppress None

When you select any error checking in Character Async/Sync following a <Reset> the HP 4951C defaults to Start on SOH STX and Stop on & ETX NUL NUL. These start and stop characters also appear if you first go to the BSC menu and then to Character Async/Sync after a <Reset>.

The Self Test Menu

Whenever you turn on the HP 4951C it first goes through a self-test. After approximately six seconds, it then displays the Top Level Menu. You can run the self-test at any time by pressing the <Self Test> softkey in the Top Level Menu. If you then press <Loop>, the analyzer goes through a self test cycle and displays failure information for specific tests. See Appendix E for more information on the Self Test Menu.

13

ASCII Printer Output

Introduction

The ASCII printer output application (supplied internally with the HP 4951C) lets you print buffer data, monitor and simulate menus, timer and counter results, and disc directories. HP 4951C display information can be sent to a printer via the Remote/Printer (RS-232C/V.24) connector on the rear panel or via the Interface Pod connector using the RS-232C/V.24 interface pod.

ITEMS REQUIRED

To use this feature, you need to access the Printer Output application under the Mass Store menu. Use an ASCII Printer such as the HP 2601A, HP 2934A or ThinkJet Printer (HP 2225D).
If you use the Remote/Printer connector on the rear panel, you need a modem eliminator cable (HP 13242G).
If you use the Interface Pod connector on the rear panel, you need an RS-232C/V.24 interface pod such as the HP 18179A or HP 18180A.

SUMMARY OF PRINTER OPERATION

Hookup. Connect the ASCII printer to the Remote/Printer connector on the rear panel or to the RS-232C/V.24 pod.

Loading. Load the printer output application program from the Mass Store Menu.

Setup. In the Top Level Menu, select Printer Menu and make the desired selections. The default conditions will work with a ThinkJet (HP 2225D) with all the back switches down.

Execution. Press <Execute> when the cursor is in any printer menu field (except the last).

Halting. Press EXIT to halt printing at any time and return to the printer menu.

Hookup

Connect the ASCII printer to the Printer/Remote connector on the rear panel using the HP 13242G cable, or to the RS-232C/V.24 interface pod, using the Y-ribbon cable supplied with the pod. See Figure 13-1 below.

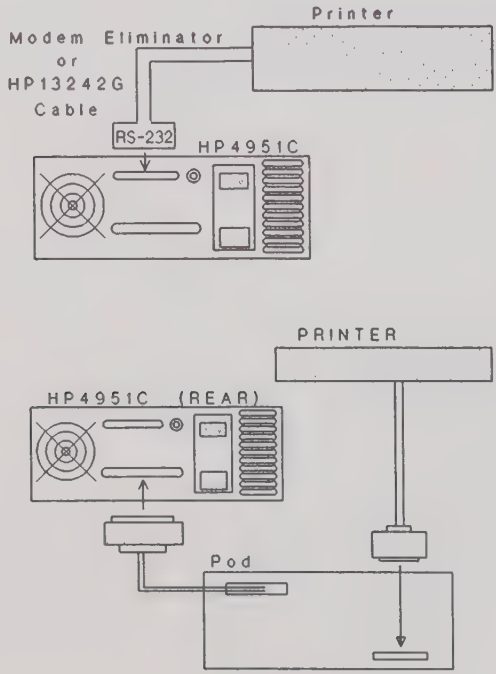


Figure 13-1. Connecting the Printer

Loading The Application

1. Press the More key in the top level menu.
2. Press the <Mass Store> softkey in the Top Level Menu.
3. Press the More key.
4. Press the <Print Appl> softkey.
5. Press <Execute> to load the printer application program.
6. The <Print> softkey should now appear on the top level menu softkeys (press MORE to see this selection).

Setup

Use the Printer Output Menu (Figure 13-2), which appears in the top level menu after loading the application, to configure for printing. You must know the correct settings for your ASCII printer.

Print Information

Select any of the displays shown on the softkeys. If you select <data buffer>, specify which buffer section is to be printed: the beginning of the buffer is displayed, with the following softkeys:

```
Print All      Start Here      Hex/Text
```

The default is "Text"; press <Hex> to represent the data in hex. The <Print All> softkey prints the entire buffer. To print only part of the buffer, move the cursor to the desired position and press <Start Here>. The following softkeys appear:

```
To End      End Here      Hex/Text
```

Press <To End> to print the buffer contents from the starting position to the end of the buffer. Otherwise move the cursor to the desired ending position. Press <End Here> to print the buffer from the starting position to the position indicated by the cursor.

Port

Select the connection you are using; either the interface pod (pod) or the Remote/ Printer connector (RS-232 Port).

Bits/sec

You can send data to the printer at any one of the speeds shown in Figure 13-2.

Character Code

Select either ASCII 8 or ASCII 7.

Parity

Select none, even, or odd.

4951C Mode

Determines whether the HP 4951C behaves as a **D**ata **T**ermination **E**quipment (**DTE**) or as **D**ata **C**ommunication **E**quipment (**DCE**).

When using the pod's Y-ribbon cable for printer connection, the HP 4951C should be configured as a DCE.

Handshake

Determines the printer handshake method. You can specify ENQ, ACK, XON, or XOFF characters by typing in the characters from the keyboard. Type in control characters, shown on the keycaps, by pressing CNTL simultaneously with the control character.

Line Terminators

Type in the line termination characters expected by the printer. Two characters may be specified, blanks are ignored. The standard sequence of a carriage return and line feed is the default.

Carriage Return Delay

Sets the delay after a carriage return in milliseconds. This field defaults to zero, but some printers require a delay to avoid a loss of characters. NOTE: The <Execute> key is not available in this field.

```
Print Information:      [ Data Buffer      ]   [ BERT Menu  ]
                        [ Setup            ]   [ Remote     ]
                        [ Monitor          ]   [ Catalog    ]
                        [ Simulate         ]   [ Print Menu ]
                        [ Run Summary      ]

Port:                   Remote  or  Pod

Bits/sec.:              [ 19200 ]  [ 7200 ]  [ 3200 ]  [ 1600  ]
                        [ 9600  ]  [ 4800 ]  [ 2000 ]  [ 14400 ]
                        [ 3600  ]  [ 2400 ]  [ 1800 ]  [ 12000 ]
                        [ 1200  ]  [ 600  ]  [ 150  ]  [ 134.5 ]
                        [ 300   ]  [ 110  ]  [ 75   ]  [ 50    ]

Character Code          [ ASCII 8 ]  [ ASCII 7 ]

Parity                  [None ]  [ Even ]  [ Odd ]

4951C Mode              [ DTE ]  [ DCE ]

Handshake               [ XON/XOFF ]  [ ENQ/ACK ]  [ Ctrl Lead ]

XON (ENQ) Character     [ keyboard entry ]
XOFF (ACK) Character    [ keyboard entry ]

Line Terminator         [ keyboard entry ]

Carriage Return Delay   [ keyboard entry ] ms
```

Figure 13-2. The Printer Output Menu

Execution

After filling out the printer output menu, press the <Execute> softkey. The <Execute> softkey appears when the cursor is in any field (except Carriage Return Delay) of the print menu. Pressing <Execute> initiates the printing process using the menu values that are currently displayed. Print menu parameters are saved, thus when you enter the print menu the next time, the fields will have the same values used for the previous print operation.
Press EXIT to halt printing at any time and return to the printer menu.

Printer Handshaking

Your printer will use one or more of the following types of handshaking. You must determine which one, and configure the analyzer printer menu appropriately.

Hardware Handshaking

The CTS and DTR leads are used for hardware handshaking. CTS is monitored by the HP 4951C when it is in the DTE mode. In the DCE mode the HP 4951C monitors DTR. If another line is to be used, the appropriate connections must be made via the interface pod breakout box. In order to print, the lead being used must be high. If the lead goes low, printing pauses until the lead goes high again.

Enquire/Acknowledge (ENQ/ACK) Handshaking

In ENQ/ACK handshaking the HP 4951C inquires whether the printer is ready to receive characters. The HP 4951C sends an ENQ character (usually 05 hex) to the printer after each block of 40 characters. The printer must acknowledge the enquiry in order for printing to proceed. The printer does not respond to an ENQ until it is able to accept more characters into its buffer. When it is ready, the printer responds by sending an ACK character (usually 06 hex) to the HP 4951C. The ENQ and ACK characters may be different for various printers. You can specify the characters to be used in the Printer Menu.

XOn/XOff Handshaking

XOn/XOff handshaking is initiated by the printer. When the printer is unable to continue receiving characters, it sends an XOff character (usually 13 hex) to the HP 4951C. The HP 4951C then suspends transmission until the printer sends an XOn character (usually 11 hex). Some printers use a second XOff character (usually 15 hex). One XOn character, and two XOff characters can be specified in the printer menu.

Error Messages

The following messages may appear at the bottom of the display. Press the EXIT key to return to the printer menu and halt printing.

1. **No pod attached.** No pod is attached to the HP 4951C.

2. **No Lead Change.** With hardware handshaking, no enabling lead has been detected for more than 60 seconds. The HP 4951C waits for an enabling lead from the printer.

3. **No XON after XOFF.** With XOn/XOff handshaking, the printer sent an XOff and has not sent an XOn for more than 60 seconds. The HP 4951C waits for the XOn character from the printer.

4. **No ACK after ENQ.** While using ENQ/ACK handshaking, the printer has not responded with an ACK for more than 60 seconds after the HP 4951C sent an ENQ. The HP 4951C waits for the ACK character from the printer.

5. **No Transmission occurring.** Check hardware connections.

To return to the printer menu after one of the above messages, press the EXIT key. Check the printer if handshaking is not acknowledged.

How The Printer Displays Characters

The output format for the ASCII printer is essentially the same as for the HP 4951C display, except as described below.

All hex codes are in upper case. All ASCII control characters are in lower case. All other sequences are: top character upper case, and lower character lower case.

All characters that have no ASCII representation are printed in hexadecimal mode.

HEXADECIMAL characters are printed in upper case, with the most significant digit over the least significant digit. For example, B7 hex is printed as:

```
B
7
```

ASCII control characters are printed in lower case with the same mnemonics as displayed except they are printed on two lines. For example, and ASCII acknowledge is printed as:

```
a
k
```

For data and state displays, after DTE, DCE, and lead level information is printed across the page, a blank line is left before the next group of lines is printed.

SPECIAL CHARACTERS

Don't Care	X X	Undefined Character	? ?
Start Flag	S f	End Flag	E f
Good FCS	GG gg	Bad FCS	BB bb
Abort	AA aa	Don't Care FCS	XX xx
Highlighted Timer	H t	Discontinuity	D c

LEAD LEVELS

Lead levels that are displayed are printed as follows:

```
High = 1          Low = 0

Transition (rising or indeterminate)      /

Transition (falling or indeterminate)     \
```

Examples Of Printed Output

EXAMPLE OF DATA & STATE DISPLAY

```
DTE:        8 A B C D EGGE     Sd  e e
            0 B C D E fggf     f1  b q
DCE:         8 A B C D    EGGE   Sd e e
             0 B C D E    fggf   f1 b q
RTS:        00000000000000000000000000
CTS:        0000000000000000/111111111
DSR:        00000000000000000000000000
CD :        00000000000000000000000000


DTE:        d d e n h s d n e u f r s d
            2 4 m k t i l u c s s s h 3
DCE:         d d e n h s d n e u f r s
             2 4 m k t i l u c s s s h
RTS:        00000000000000000000000000
CTS:        11111111111111111111111111
DSR:        00000000000000000000000000
CD :        00000000000000000000000000
```

EXAMPLE OF FRAME & PACKET OUTPUT

```
Block 1
        A Type      NS PS NR Data     FCS                  QD Mod LCN  PS M  PR

DCE:    0 INFO      0  0  0  UUd      G      Clear Request 01  8  555
        0                        3     g

DCE:    0 INFO      0  0  0  DDv      G      Call Request  01  8  444
        0                        t     g

DCE:    0 INFO      0  0  0  UUd      G      Clear Request 01  8  555
        0                        3     g

DCE:    0 INFO      0  0  0  DDv      G      Call Request  01  8  444
        0                        t     g
```

EXAMPLE OF RUN SUMMARY

```
Protocol        Char Async/Sync
Bit order       LSB 1st                    Bit Sense       Norm.
Code            ASCII 8                    Err chk         None
Parity          None
Transpar        None
Mode            Async 1

                                           Bits/sec        9600
                                           Disp mode       D & S
                                           Suppress        None

Counter 1 =       0                      Timer 1 =       0
Counter 2 =       0                      Timer 2 =       0
Counter 3 =       0                      Timer 3 =       0
Counter 4 =       0                      Timer 4 =       0
Counter 5 =       0                      Timer 5 =       0
```

14

Examples

EXAMPLE 1 MEASURING A SINGLE RTS-CTS DELAY

This test measures the time from when RTS goes on until CTS goes on. Use the <Monitor> menu for this example.

To view the timers and counters, press <Summary> during run-time, or <Timer & Cntr> in the Examine Data Menu after run-time.

Note that timer measurements must be referenced to a preceding trigger for accurate measurements.

PROGRAM		DESCRIPTION
Block 1:	When Lead RTS goes On then goto Block 2	
Block 2:	Start Timer 1	Timer 1 indicates RTS-CTS delay.
	When Lead CTS goes On then goto Block 3	Note that Start and Stop statements must be preceded by When statements for accurate timing.
Block 3:	Stop Tests	

EXAMPLE 2 MONITORING A DCE

In this example, you monitor a DCE by simulating the DTE through the <Simulate> menu. When simulating a DTE, the HP 4951C supplies the ETC clock. Upon receiving the proper clocks and lead commands, the DCE begins sending data, which the HP 4951C automatically stores and displays while in the simulate mode.

```
Simulate DTE

Block 1:      Set Lead DTR  On
                and then

              Set Lead RTS  On
```


EXAMPLE 3 MONITORING A DTE

In this example, you monitor a DTE by simulating a DCE. When simulating a DCE, the HP 4951C automatically supplies both the TC and RC clocks. Upon receiving the proper clocks and lead commands, the DTE begins sending data, which the HP 4951C automatically stores and displays while in the simulate mode.

```
Simulate DCE

Block 1:      Set Lead DSR  On
                and then
              Set Lead CD  On
                and then
              Set Lead CTS  On
```

EXAMPLE 4 FOX MESSAGE

This test checks the ability of asynchronous terminals and printers to receive and display data. The "FOX" message is transmitted to the terminal using the <Simulate> menu and then the echo from the terminal is checked for parity errors.

```
Simulate DCE

Block 1:    Send THE QUICK BROWN FOX
            JUMPS OVER A LAZY DOG 012
            3456789.

Block 2:    When Error Parity on DTE
              then goto Block 3
            When DCE .
              then goto Block 1

Block 3:    Increment Counter 1
              and then
            Goto Block 2
```

EXAMPLE 5 COUNTING PARITY ERRORS

This program uses the <Monitor> menu to count the number of parity errors on both the DTE and DCE lines and keep track of the number of minutes of the test.

Block 1:	When DTE X or When DCE X then goto Block 2	Timer 5 starts when any character is sent on the DTE or DCE line. ("X" = don't care.)
Block 2:	Start Timer 5	Timer 5 counts milliseconds up to one minute.
Block 3:	When Error Parity on DTE then goto Block 4 When Error Parity on DCE then goto Block 5 When Timer 5 is > 59999 then goto Block 6	
Block 4:	Increment Counter 1 and then Goto Block 3	Counter 1 indicates DTE errors.
Block 5:	Increment Counter 2 and then Goto Block 3	Counter 2 indicates DCE errors.
Block 6:	Increment Counter 5 and then Reset Timer 5 and then Goto Block 2	Counter 5 keeps track of the number of minutes into the test.

EXAMPLE 6 MEASURING MORE THAN ONE RTS-CTS DELAY

This test measures RTS-CTS delays until stopped. Use the <Monitor> Menu for this example.

Timer 1 and Timer 2 measure alternate delays. If only one timer were used, you would not have had enough time to see the timer before it was reset.

To view the timers and counters press <Summary> in the Run Menu during run-time. After run-time press <Timer & Counter> in the Examine Data Menu.

```
Block 1:    When Lead RTS goes On
              then goto Block 2

Block 2:    Reset Timer 1                    Timer 1 measures the first
              and then                       RTS-CTS delay.
            Start Timer 1

            When Lead CTS goes On            The two "When" statements
              then goto Block 3              are ORed together.
            When Lead RTS goes Off
              then goto Block 6

Block 3:    Stop Timer 1

            When Lead RTS goes On            You can now view timer 1
              then goto Block 4              while the analyzer finds
                                             the next delay.
```

Block 4:	Reset Timer 2 and then Start Timer 2	Blocks 3-5 duplicate blocks 1-2. Timer 2 now measures the next RTS-CTS delay. Thus,
	When Lead CTS goes On then goto Block 5	the user has time to view timer 1 before it is reset.
	When Lead RTS goes Off then goto Block 6	The two "When" statements are ORed.
Block 5:	Stop Timer 2 and then Goto Block 1	Control is looped back to Block 1.
Block 6:	Reset Timer 1 and then Reset Timer 2 and then Beep and then Goto Block 1	If RTS goes off before CTS goes on the timers are reset and an alarm "beep" occurs.

EXAMPLE 7 SIMULATING RTS-CTS DELAY

In this test, you substitute the HP 4951C for the DTE. Thus, you can test the modem in isolation.

Timer 1 measures the time it takes for the modem to respond with CTS on.

```
Simulate DTE

Block 1:    Set Lead RTS On

            When Lead RTS goes On
               then goto Block 2

Block 2:    Reset Timer 1
               and then
            Start Timer 1
               and then
            Start Timer 5

            When Lead CTS goes On
               then goto Block 3
            When Timer 5 > 2000
               then goto Block 4
```

Timer 1 is reset because the program later loops back to this block.

Timer 1 shows CTS response time.

Timer 5 causes the instrument to beep if CTS does not go on within 2 seconds

Block 3:

Reset Timer 5
and then
Stop Timer 1
and then
Set Lead RTS Off
and then
Wait 29999
and then
Goto Block 1

RTS is now turned off and the test begun again after 30 seconds. (You can change this delay.)

Block 4:

Reset Timer 5
and then
Reset Timer 1
and then
Beep
and then
Set Lead RTS Off
and then
Wait 250
and then
Goto Block 1

Block 4 is the "error block". If CTS does not go on two seconds after RTS goes on, the analyzer beeps and restarts the test.

EXAMPLE 8 LOOPBACK

In this test, the local modem is looped back. The HP 4951C is substituted for the DTE and sends the "Quick Brown Fox" message 100 times. The modem is checked for proper handshaking and echo response.

```
Simulate DTE

Block 1:    Set Lead RTS On
              and then
            Start Timer 5

            When Lead CTS goes On          The modem is checked for
              then goto Block 2            correct handshaking response.

            When Timer 5 is > 2000         Timer 5 indicates whether the modem
              then goto Block 8            responds within 2 seconds.

Block 2:    Reset Timer 5                  Timer 5 is reset for the next loop.
              and then
            Send THE QUICK BROWN FOX       The message is sent to the
            JUMPS OVER A LAZY DOG 012      modem.
            3456789.
              and then
            Set lead RTS Off
```

Block 3:	When DCE THE QUICK BROWN FOX JUMPS OVER A LAZY DOG 0123456789 then goto Block 5 When Lead CTS goes Off then goto Block 4	The modem is checked to see whether it echoes back each character. Because the two "when" statements are ORed, every character must be received before CTS goes off.
Block 4:	Increment Counter 2	Counter 2 indicates the number of times this does not happen.
Block 5:	Increment Counter 1 If Counter 1 is > 99 then goto Block 7	Counter 1 shows the total number of transactions up to 100.
Block 6:	Goto Block 1	The test starts over.
Block 7:	Stop Tests	
Block 8:	Reset Timer 5 and then Beep and then Goto Block 1	An alarm "beep" indicates a lack of modem response.

EXAMPLE 9 END-TO-END: TRANSMIT FIRST (HP 4925B Compatible)

The End-to-End test consists of the two programs described in Examples 9 and 10.

In the End-to-End Test, two HP 4951C's (or an HP 4951C and an HP 4925B) are substituted for the DTE's at both ends of a line. Handshaking and messages are performed and checked 100 times. Except for the fact that one DTE transmits first, and the other DTE receives first, both programs are identical. There are two sections to this program: In blocks 5-6 this DTE is transmitting; in blocks 1-4 this DTE is receiving. Counter 1 indicates how many times the test failed. Counter 2 indicates the total number of transactions.

NOTE: The "receive first" unit must be started first.

The proper setup is necessary for this test. Use the Char Async/Sync Menu with all the default selections (Chapter 12) except the following:

Data Code Hex 8 Drop sync 4 chrs after $1_8\ 1_8\ 1_8\ 1_8\ 1_8\ 1_8\ 1_8\ 1_8$

Sync on $F_F\ 9_3$

```
Simulate DTE

Block 1:    Goto Block 6                    The program immediately
                                            jumps to the transmit
                                            section.

Block 2:    Set Lead DTR On
            If Lead CD is On                The If and When statements
              then goto Block 3             are ORed.
            When Lead CD goes On
              then goto Block 3
```

Block 3:	When Lead CD goes Off then goto Block 4 When DCE 7 B F 4 / 6 3 A 1 then goto Block 5	The two When statements are ORed: If CD goes off before the message is received, then the error counter is incremented. The DCE characters are the same as those sent by the HP 4925B
Block 4:	Beep and then Increment Counter 1	
Block 5:	Increment Counter 2	Counter 2 tells total transactions.
Block 6:	Wait 100 msec and then	The transmit section of the program begins.
	Set Lead RTS On	
	If Lead CTS is On then goto Block 7 When Lead CTS goes On then goto Block 7	
Block 7:	Send F 9 7 B F 4 1 / F 3 6 3 A 1 8	This is the same message sent by a HP 4925B
	When DTE 1 / 8 then goto Block 8	
Block 8:	Set Lead RTS Off	
	If Counter 2 > 99 then goto Block 10	When Counter 2 reaches 100, the test is ended.
Block 9:	Goto Block 2	
Block 10:	Stop Tests	

EXAMPLE 10 END-TO-END: RECEIVE FIRST (HP 4925B Compatible)

This is the part of the END-TO-END TEST for the DTE which receives first. There are two sections to the program: In blocks 1-4 the DTE is transmitting; in blocks 5-6 the DTE is receiving. Counter 2 tells how many times the test failed. Counter 1 keeps track of the total number of transactions.

NOTE: The "receive first" unit must be started first.

Use the Char Async/Sync Menu for the setup. Use all the default selections (see Chapter 12) except the following:

Data Code Hex 8 Drop sync 4 chrs after $1_8\ 1_8\ 1_8\ 1_8\ 1_8\ 1_8\ 1_8$

Sync on $F_F\ 9_3$

Simulate DTE

Block 1:	Set Lead DTR On If Lead CD is On then goto Block 2 When Lead CD goes On then goto Block 2	This is the Receive portion of the End-to-End test.
Block 2:	When Lead CD goes Off then goto Block 3 When DCE $7_6\ B_3\ F_A\ 4_1$ then goto Block 4	These two When statements are Ored. If CD goes off before this DTE has received the message, Counter 1 will indicate another failure.

Block 3:	Beep and then Increment Counter 1	
Block 4:	Increment Counter 2	Counter 2 indicates another transaction.
Block 5:	Wait 100 msec and then Set Lead RTS On	The transmit section of the program begins.
	If Lead CTS is On then goto Block 6 When Lead CTS goes On then goto Block 6	
Block 6:	Send $^{F}_{F}\ ^{9}_{3}\ ^{7}_{6}\ ^{B}_{3}\ ^{F}_{A}\ ^{4}_{1}\ ^{1}_{8}$	This is the same message as that sent by an HP 4925B
	When DTE $^{1}_{8}$ then goto Block 7	
Block 7:	Set Lead RTS Off	
	If Counter 2 > 99 then goto Block 9	When the total transactions = 100 the test is ended.
Block 8:	Goto Block 1	
Block 9:	Stop Tests	

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The Interface

Introduction

An interface pod is required to connect the HP 4951C to the data line. The interface pod also forms the cover of the instrument. Interface pods are available for both the RS-232C/V.24 and RS-449 interfaces.

RS-232C/V.24 Interfaces

HP 18179A — This interface pod uses LEDs for showing all three conditions of the line: marks, spaces, and high impedance. Because it has a complete breakout box, this pod is useful for level 1 troubleshooting.

HP 18180A — This interface pod contains both a EIA RS-232C / CCITT V.24 interface and an RS-449/422A/423A interface.

The RS-232C is compatible with MIL-188C. Ten switches are provided for line isolation. LCD indicators indicate only line activity on: TD, RD, TC, RC, DTR, DSR, RTS, CTS, CD. A manually connected MARK/SPACE monitor is available.

The RS-449 interface utilizes balanced RS-422A drivers. LCD indicators indicate only line activity on: SD, RD, ST, RT, RS, CS, TR, DM, RR.

RS-449 Interfaces

HP 18180A — This interface pod contains both a EIA RS-232C / CCITT V.24 interface and an RS-449/422A/423A interface.

The RS-449 interface utilizes balanced RS-422A drivers. LCD indicators indicate only line activity on: SD, RD, ST, RT, RS, CS, TR, DM, RR.

The RS-232C is compatible with MIL-188C. Ten switches are provided for line isolation. LCD indicators indicate only line activity on: TD, RD, TC, RC, DTR, DSR, RTS, CTS, CD. A manually connected MARK/SPACE monitor is available.

HP 18174A — This interface pod contains a RS-449/422A/423A interface. The RS-449 interface utilizes balanced RS-422A drivers. LCD indicators indicate only line activity on: SD, RD, ST, RT, RS, CS, TR, DM, RR.

HP 18177A — This pod contains hardware for the V.35 interface. This interface pod uses LEDs for showing all three conditions of the line: marks, spaces, and high impedance. The lines monitored are: DTE, DCE, SCE, SCT, SCR, RS, DTR, CS, DSR, CD.

Pod Installation

To connect the Interface Pod to the HP 4951C Protocol Analyzer, set the HP 4951C power switch to off and attach the interface pod cable to the Interface Pod connector on the rear panel. Tighten the connector screws to ensure that the cable will not pull off during operation.

CAUTION

Turn off the Protocol Analyzer before connecting or disconnecting any Interface Pod.

The pod can be secured to the top of the analyzer's pouch by using the strap provided on the pouch.

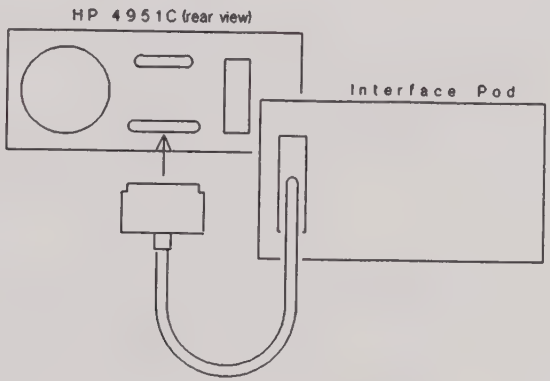

Figure 15-1. Interface Pod Connection

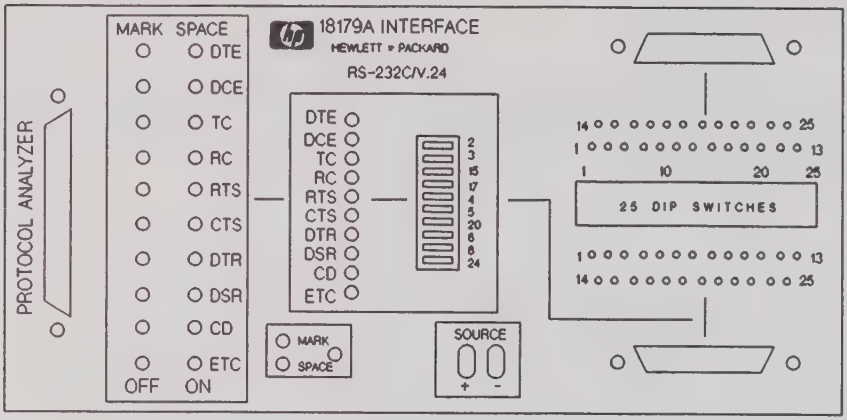

Figure 15-2. The HP 18179A Interface Pod

The HP 18179A Interface Pod (RS-232C/V.24)

The HP 18179A is an RS-232C/V.24 interface pod which connects the HP 4951C to the DTE or DCE. The HP 18179A is compatible with CCITT V.24 and EIA RS-232C electrical, mechanical, functional, and procedural specifications.

The HP 18179A can be used for complete level 1 troubleshooting on RS-232C/V.24 interfaces. It contains 10 pairs of real-time LEDs which monitor data, clocks, and major control line activity.

The LEDs show all three possible line states. The green LEDs indicate "on" states, or valid spaces. The red LEDs indicate "off" states, or valid marks. The high impedance state is indicated when both the red and the green LEDs on a line are not lit. The LEDs also indicate real-time activity; that is they show actual transitions.

The HP 18179A also contains a complete breakout with switches for interrupting each of the the 25 conductors. Access to all 25 pins is provided by a complete set of 25 pins on each side of the switches, allowing you to connect any interface pin to any other.

In the DTE and DCE simulate modes RS-232C/V.24 drivers are switched into the appropriate lead by latching relays. If monitor mode is selected all RS-232C/V.24 drivers are disconnected from the line.

LEDs

The 3-state indicators indicate activity on the interface pins. The high impedance state is indicated when both LEDs are off.

green: space (logic '0', positive voltage) turns on at >2.75 V, turns off at <0.25 V

red: mark (logic '1', negative voltage) turns on at < -3.0 V, turns off at > -3.0 V

Disconnect Switches

Pins 2, 3, 4, 5, 6, 8, 15, 17, 20, and 24 may be individually disconnected from the data link by switches. This lets you isolate non-driven interface lines from the HP 4951C. Non-driven lines may develop cross talk noise which can be mistaken by the analyzer for transitions.

Connectors for RS-232C/V.24 Y-Cable

These connectors connect the Interface Pod to the line for monitoring or simulation. Connect the Y-cable to the top connector to include the breakout box in series with the line. Connect the Y-cable to the bottom connector to by-pass the breakout box.

Full Breakout Box

The Breakout Box provides cross-patching, line-forcing, and monitoring capabilities for all of the RS-232C/V.24 lines. The miniature switches isolate lines. Connect the Y-cable to the top connector to use the breakout box.

Jumper Pins

All 25 pins of the RS-232C/V.24 connector are brought out for jumpering on both sides of the breakout switches. If your network cable has different pin assignments from the interface standard, you can use the supplied jumper wires to connect the interface lines to the desired pin on your cable.

+/-12 V Source Pins

The Source Pins supply +12 volts and - 12 volts. You may set any signal line on or off by jumpering that line to the Source Pins.

Mark/Space Indicator

The Mark/Space Indicator lets you check the level of any signal line. Jumper any pin to this indicator to find its state.

Instrument Cable Connector

This connector connects the Interface Pod to the HP 4951C via the Pod-Instrument cable supplied with the instrument.

RS-232/V.24 INTERFACE (HP18179A, and 18180A)

Pin	Circuit	Function	EIA	CCITT Source
1	GND	Protective Ground	AA	101 ...
2	TD	Transmitted Data	BA	103 DTE
3	RD	Received Data	BB	104 DCE
4	RTS	Request To Send	CA	105 DTE
5	CTS	Clear To Send	CD	106 DCE
6	DSR	Data Set Ready	CC	107 DCE
7	GND	Ground Signal	AB	102 ...
8	CD	Carrier Detect	CF	109 DCE
9-11	...	unassigned	...	... ...
12	SCD	Sec Carrier Detect	SCF	122 DCE
13	SCS	Sec Clear To Send	SCB	121 DCE
14	STX	Sec Transmitted Data	SBA	118 DTE
15	TC	Transmit Clock	DB	114 DCE
16	SRD	Sec Received Data	SBB	119 DCE
17	RC	Received Clock	DD	115 DCE
18	...	unassigned	...	... ...
19	SRS	Sec Request to Send	SCA	120 DTE
20	DTR	Data Terminal Ready	CD	108.2 DTE
21	SQ	Signal Quality	CG	110 DCE
22	RI	Ring Indicator	CE	125 DCE
23	DRS	Data Rate Selector	CH	111 DTE
			CI	112 DCE
24	ETC	Ext Transmit Clock	DA	113 DTE
25	...	unassigned	...	... ...

The HP 18180A (Combination RS-232C/V.24 and RS-449)

The HP 18180A is an RS-232C/V.24 interface pod as well as RS-449/422A/423A. The HP 18180A has slightly less capability than the HP 18179A pod. Its LCD indicators show only "on" or space states. Also, unlike the HP 18179A, the HP 18180A does not contain a full breakout box.

Connectors

The top connector, labeled PROTOCOL ANALYZER, connects the interface pod to the HP 4951C via the Pod-Instrument cable supplied with the instrument. The bottom connector, labeled RS-232C/V.24 connects the Interface to the line for monitoring or simulation (see Chapter 2 for Hookup).

Jumper Pins

All 25 pins of the bottom connector are brought out for jumpering. If your network cable has different pin assignments from the interface standard, you can use the supplied jumper wires to connect the interface lines to the desired pin on your cable. Pins 2, 3, 4, 5, 6, 8, 15, 17, 20, and 24 are also brought out on the other side of the breakout switches for jumpering.

Source Pins

The six Source Pins supply +12 volts and -12 volts. You may set any signal line on or off by jumpering that line to the Source Pins.

Disconnect (breakout) Switches

Pins 2, 3, 4, 5, 6, 8, 15, 17, 20, and 24 may be individually disconnected from the data link by means of switches. This lets you isolate non-driven interface lines from the HP 4951C.

LCD Indicators

The LCD indicator for a signal line is dark when that line is On or Spacing. The LCD indicator is blank when a line is Off, Marking, or in tri-state. For the indicator to be dark the voltage on that line must be greater than +2.75 volts. Once the indicator is dark, it will not go blank until the voltage becomes less than +0.25 volts. Therefore, the LCD for individual lines do not distinguish Marking and tri-state. Use the Mark/Space Monitor to do this.

LCD Indicator	Interface Line
Dark	Logical "0" (Space, On, positive voltage)
Blank	Logical "1" (Mark, Off, negative voltage, tri-state)

Mark/Space Monitor

Use the Mark/Space Monitor Pin to check the level of any signal line. Jumper this pin to any signal pin and observe the ON/OFF LCD indicators. The On indicator is darkened for levels greater than +3 volts; the Off indicator is darkened for levels less than -3 volts. The other LCD indicators do not distinguish between Marking and tri-state conditions (they are blank below +0.25 volts). The Mark/Space Monitor lets you check these lines, or any other signal lines for mark/space levels.

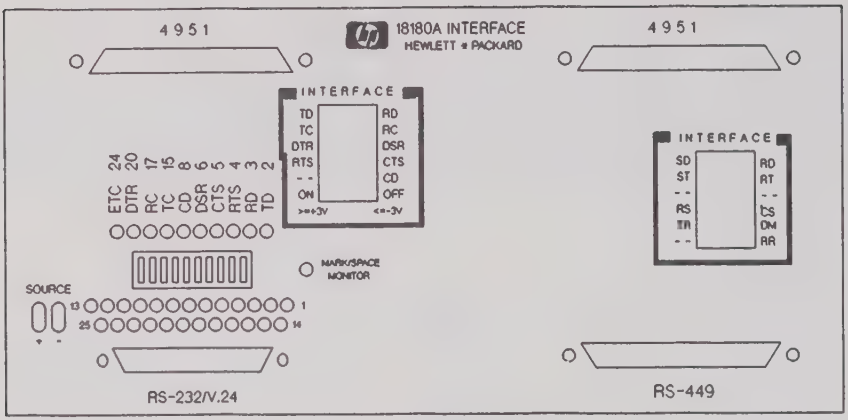

Figure 15-3. The HP 18180A (Combination RS-232C/V.24 and RS-449)

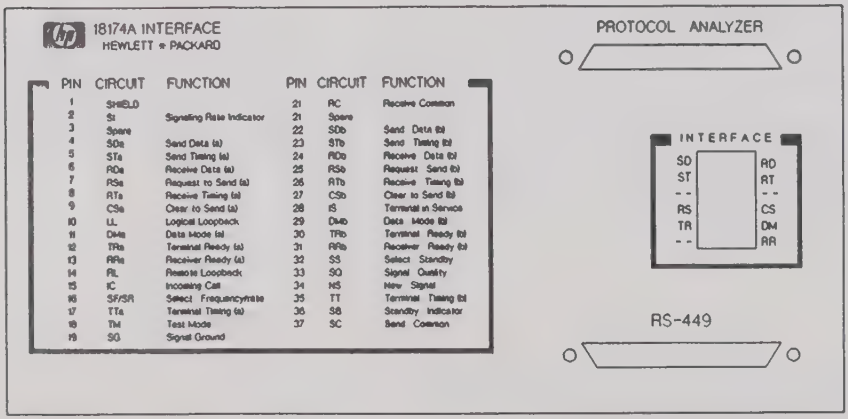

Figure 15-4. The HP 18174A (RS-449 Interface)

The HP 18174A (RS-449)

The HP 18174A follows the EIA RS-449/422A/423A standard. The RS-449 was intended by the Standards Committees as a replacement and enhancement for the RS-232C/V.24 interface and can be used for both low and high-speed applications. RS-449 is made up of two electrical standards, RS-423A and RS-422A.

The RS-422A uses a balanced signal lead configuration for data and clocks to enable high speed operation. RS-423A uses an unbalanced signal lead configuration. Because the HP 4951C implements RS-422A electrical standards for all category I circuits, it can also support RS-423A circuits.

The 18174A interface does not have an integral breakout box for disconnecting and jumpering lines. Selected pins are, however, monitored by LCD indicators. For the LCD indicators to transition, the unbalanced or differential A-B voltage must be greater than 0.2 volts.

The RS-449 Interface

Pin	Circuit	Function
1	SHIELD	
2	SI	Signaling Rate Indicator
3	Spare	
4	SDa	Send Data (a)
5	STa	Send Timing (a)
6	RDa	Receive Data (a)
7	RSa	Request to Send (a)
8	RTa	Receive Timing (a)
9	CSa	Clear to Send (a)
10	LL	Local Loopback
11	DMa	Data Mode (a)
12	TRa	Terminal Ready (a)
13	RRa	Receiver Ready (a)
14	RL	Remote Loopback
15	IC	Incoming Call
16	SF/SR	Select Frequency/rate
17	TTa	Terminal Timing (a)
18	TM	Test Mode
19	SG	Signal Ground

Pin	Circuit	Function
20	RC	ReceiveCommon
21	Spare	
22	SD	b Send Data (b)
23	STb	Send Timing (b)
24	RDb	Receive Data (b)
25	RSb	Request Send (b)
26	RTb	Receive Timing
27	CSb	Clear to Send
28	IS	Terminal in Service
29	DMb	Data Mode (b)
30	TRb	Terminal Ready (b)
31	RRb	Receiver Ready (b)
32	SS	Select Standby
33	SQ	Signal Quality
34	NS	New Signal
35	TT	Terminal Timing
36	SB	Standby Indicator
37	SC	Send Common

The HP 18177A (V.35 Interface)

This pod is a V.35 interface. The HP 18177A follows V.28/V.35 electrical specifications, V.24 functional specifications, and ISO 2593 mechanical specifications.

The mark/space LEDS can indicate a Mark or a Space. If both are off at the same time the indication is that no signal is present on the line.

The HP 18177A specifies a differential voltage resolution on Mark/Space detect of .55 volts +-30% for Data and Clock lines.

The V.28 control lines are specified as follows:

```
OFF LED on indicates < -2.8 volts on the line.
ON LED on indicates > .25 volts on the line.
Neither LED on indicates -2,8 < volts < .25 on the line.
```

The outputs of the control lines RS, DTR, CS, DSR, RLSD conform to the CCITT V.28 electrical standard (same as RS-232C). This entails -12 volts for a mark (1, off) and +12 volts for a space (0, on).

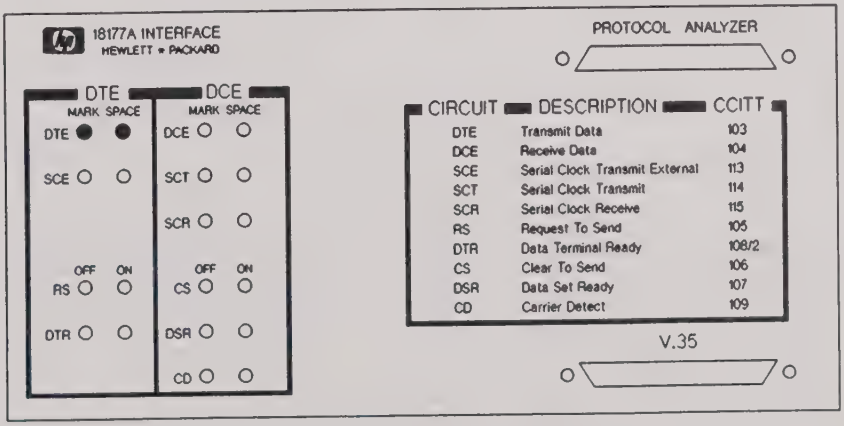

Figure 15-5. The HP 18177A (Interface)

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JIS Option

Introduction

The JIS option for the HP 4951C lets you display the JIS-7, JIS-8 or EBCDIK Katakana Data Codes during protocol analysis. This is a ROM replacement option which provides a character ROM for the Katakana character dot patterns and four System Code ROMs. See the HP 4951C Service Manual for more information.

The Setup Menu

The HP 4951C functions normally in all respects with this option except that Data Code field choices EBCD, Transcode and IPARS are replaced with JIS-8, JIS-7 and EBCDIK. Thus, the JIS Option modifies the Setup menu depending on the protocol.

The HDLC, SDLC and X.25 protocol menus add the choice of JIS-8 and EBCDIK to the choices of HEX-8, EBCDIC and ASCII-8 to the Data Code field.

The Character Async/Sync menu replaces the EBCD, IPARS0, IPARS1 and Transcode Data Field choices with the JIS-7, JIS-8 and EBCDIK choices.

The BSC menu replaces the Transcode Data Code choice with the JIS-8 and EBCDIK choices. Also, the defaults for Sync Chars and Parity are set to $^{1}_{6}$ $^{1}_{6}$ and None for JIS-8, and $^{3}_{2}$ $^{3}_{2}$ and None for EBCDIK.

Monitor/Simulate Menu

Trigger strings and Send strings both function in a similar manner. ASCII control and text characters may be entered from the keyboard for JIS-8 and JIS-7. JIS-8 characters must be entered in hex code. A Katakana character can be viewed by moving the cursor to the character and pressing the <Text> softkey. JIS-7 characters should be entered in binary with the 8th bit set to "one" and then convert them to Text mode. This allows the parity bit to be set correctly. You can also enter JIS-7 characters in hex code, but you must preceed the JIS-7 characters with a Shift Out (SO) character and end the JIS-7 characters with a Shift In (SI).

Control and text characters in EBCDIK (excluding lower case) may be entered from the keyboard in Text mode. Katakana characters should be entered in Hex mode and converted as above. Some Katakana characters can be entered by typing lower case letters in Text mode.

Character conversion tables for JIS-7, JIS-8 and EBCDIK start on the next page.

Run Menu and Examine Data

Data containing Katakana characters is displayed when any operation except BERT is selected in the Run Menu and in Examine Data. JIS-8 and EBCDIK characters are displayed automatically and corresponding Hex values are displayed as described above. JIS-7 characters are displayed by looking for SHIFT IN (SI) and SHIFT OUT (SO) characters as the data is entering the box and keeping track of which mode the data is in. If the data is in the shifted mode the eighth bit of the data is set before being stored in the buffer. The JIS-7 data now appears as JIS-8 data except for codes $^{8}_{0}$ to $^{9}_{F}$ which appear as the ASCII control characters. If the Hex format is selected in either the Run Menu or Examine Data, the eighth bit is masked out and the correct Hex value for JIS-7 is displayed. Parity is checked but not stored.

Auto Configure

Using Auto Configure causes JIS-8 to be selected instead of ASCII-8, JIS-7 instead of ASCII-7, and EBCDIK instead of EBCDIC for the system Data Code.

Character conversion tables for JIS-7, JIS-8 and EBCDIK start on the next page.

JIS-7 Character Conversion Table

Dec Value	Binary	Hex	Displayed Character	Dec Value	Binary	Hex	Displayed Character
0	000 0000	00	NU	45	010 1101	2D	ュ
1	000 0001	01	SH	46	010 1110	2E	ョ
2	000 0010	02	SX	47	010 1111	2F	ッ
3	000 0011	03	EX	48	011 0000	30	ー
4	000 0100	04	ET	49	011 0001	31	ア
5	000 0101	05	EQ	50	011 0010	32	イ
6	000 0110	06	AK	51	011 0011	33	ウ
7	000 0111	07	BL	52	011 0100	34	エ
8	000 1000	08	BS	53	011 0101	35	オ
9	000 1001	09	HT	54	011 0110	36	カ
10	000 1010	0A	LF	55	011 0111	37	キ
11	000 1011	0B	VT	56	011 1000	38	ク
12	000 1100	0C	FF	57	011 1001	39	ケ
13	000 1101	0D	CR	58	011 1010	3A	コ
14	000 1110	0E	SO	59	011 1011	3B	サ
15	000 1111	0F	SI	60	011 1100	3C	シ
16	001 0000	10	DL	61	011 1101	3D	ス
17	001 0001	11	D1	62	011 1110	3E	セ
18	001 0010	12	D2	63	011 1111	3F	ソ
19	001 0011	13	D3	64	100 0000	40	タ
20	001 0100	14	D4	65	100 0001	41	チ
21	001 0101	15	NK	66	100 0010	42	ツ
22	001 0110	16	SY	67	100 0011	43	テ
23	001 0111	17	EB	68	100 0100	44	ト
24	001 1000	18	CN	69	100 0101	45	ナ
25	001 1001	19	EM	70	100 0110	46	ニ
26	001 1010	1A	SB	71	100 0111	47	ヌ
27	001 1011	1B	EC	72	100 1000	48	ネ
28	001 1100	1C	FS	73	100 1001	49	ノ
29	001 1101	1D	GS	74	100 1010	4A	ハ
30	001 1110	1E	RS	75	100 1011	4B	ヒ
31	001 1111	1F	US	76	100 1100	4C	フ
32	010 0000	20	(space)	77	100 1101	4D	ヘ
33	010 0001	21	｡	78	100 1110	4E	ホ
34	010 0010	22	｢	79	100 1111	4F	マ
35	010 0011	23	｣	80	101 0000	50	ミ
36	010 0100	24	､	81	101 0001	51	ム
37	010 0101	25	･	82	101 0010	52	メ
38	010 0110	26	ヲ	83	101 0011	53	モ
39	010 0111	27	ァ	84	101 0100	54	ヤ
40	010 1000	28	ィ	85	101 0101	55	ユ
41	010 1001	29	ゥ	86	101 0110	56	ヨ
42	010 1010	2A	ェ	87	101 0111	57	ラ
43	010 1011	2B	ォ	88	101 1000	58	リ
44	010 1100	2C	ャ	89	101 1001	59	ル

JIS-7 Character Conversion Table (cont.)

Dec Value	Binary	Hex	Displayed Character
90	101 1010	5A	レ
91	101 1011	5B	ロ
92	101 1100	5C	ワ
93	101 1101	5D	ン
94	101 1110	5E	゛
95	101 1111	5F	°
96	110 0000	60	`hex
97	110 0001	61	hex
98	110 0010	62	`hex`
99	110 0011	63	hex
100	110 0100	64	(hex)
101	110 0101	65	hex
102	110 0110	66	{hex}
103	110 0111	67	hex}
104	110 1000	68	{hex`
105	110 1001	69	`hex.
106	110 1010	6A	hex`
107	110 1011	6B	`hex.
108	110 1100	6C	hex`
109	110 1101	6D	hex`
110	110 1110	6E	hex
111	110 1111	6F	hex
112	111 0000	70	hex
113	111 0001	71	hex`
114	111 0010	72	hex
115	111 0011	73	hex
116	111 0100	74	hex
117	111 0101	75	hex
118	111 0110	76	hex
119	111 0111	77	hex
120	111 1000	78	hex
121	111 1001	79	hex
122	111 1010	7A	hex
123	111 1011	7B	hex
124	111 1100	7C	hex
125	111 1101	7D	hex
126	111 1110	7E	hex
127	111 1111	7F	

JIS-8 Character Conversion Table

Dec Value	Binary	Hex	Displayed Character	Dec Value	Binary	Hex	Displayed Character
0	000 0000	00	NU	45	010 1101	2D	-
1	000 0001	01	SH	46	010 1110	2E	.
2	000 0010	02	SX	47	010 1111	2F	/
3	000 0011	03	EX	48	011 0000	30	0
4	000 0100	04	ET	49	011 0001	31	1
5	000 0101	05	EQ	50	011 0010	32	2
6	000 0110	06	AK	51	011 0011	33	3
7	000 0111	07	BL	52	011 0100	34	4
8	000 1000	08	BS	53	011 0101	35	5
9	000 1001	09	HT	54	011 0110	36	6
10	000 1010	0A	LF	55	011 0111	37	7
11	000 1011	0B	VT	56	011 1000	38	8
12	000 1100	0C	FF	57	011 1001	39	9
13	000 1101	0D	CR	58	011 1010	3A	
14	000 1110	0E	SO	59	011 1011	3B	.
15	000 1111	0F	SI	60	011 1100	3C	<
16	001 0000	10	DL	61	011 1101	3D	=
17	001 0001	11	D1	62	011 1110	3E	>
18	001 0010	12	D2	63	011 1111	3F	?
19	001 0011	13	D3	64	100 0000	40	@
20	001 0100	14	D4	65	100 0001	41	A
21	001 0101	15	NK	66	100 0010	42	B
22	001 0110	16	SY	67	100 0011	43	C
23	001 0111	17	EB	68	100 0100	44	D
24	001 1000	18	CN	69	100 0101	45	E
25	001 1001	19	EM	70	100 0110	46	F
26	001 1010	1A	SB	71	100 0111	47	G
27	001 1011	1B	EC	72	100 1000	48	H
28	001 1100	1C	FS	73	100 1001	49	I
29	001 1101	1D	GS	74	100 1010	4A	J
30	001 1110	1E	RS	75	100 1011	4B	K
31	001 1111	1F	US	76	100 1100	4C	L
32	010 0000	20	space	77	100 1101	4D	M
33	010 0001	21	!	78	100 1110	4E	N
34	010 0010	22	"	79	100 1111	4F	O
35	010 0011	23	#	80	101 0000	50	P
36	010 0100	24	$	81	101 0001	51	Q
37	010 0101	25	%	82	101 0010	52	R
38	010 0110	26	&	83	101 0011	53	S
39	010 0111	27	'	84	101 0100	54	T
40	010 1000	28	(	85	101 0101	55	U
41	010 1001	29	)	86	101 0110	56	V
42	010 1010	2A	*	87	101 0111	57	W
43	010 1011	2B	+	88	101 1000	58	X
44	010 1100	2C	,	89	101 1001	59	Y

JIS-8 Character Conversion Table (cont.)

Dec Value	Binary	Hex	Displayed Character	Dec Value	Binary	Hex	Displayed Character
90	101 1010	5A	Z	135	1000 0111	87	(hex)
91	101 1011	5B	[	136	1000 1000	88	(hex)
92	101 1100	5C	¥	137	1000 1001	89	(hex)
93	101 1101	5D	]	138	1000 1010	8A	(hex)
94	101 1110	5E	^	139	1000 1011	8B	(hex)
95	101 1111	5F	_	140	1000 1100	8C	(hex)
96	110 0000	60	`	141	1000 1101	8D	(hex)
97	110 0001	61	a	142	1000 1110	8E	(hex)
98	110 0010	62	b	143	1000 1111	8F	(hex)
99	110 0011	63	c	144	1001 0000	90	(hex)
100	110 0100	64	d	145	1001 0001	91	(hex)
101	110 0101	65	e	146	1001 0010	92	(hex)
102	110 0110	66	f	147	1001 0011	93	(hex)
103	110 0111	67	g	148	1001 0100	94	(hex)
104	110 1000	68	h	149	1001 0101	95	(hex)
105	110 1001	69	i	150	1001 0110	96	(hex)
106	110 1010	6A	j	151	1001 0111	97	(hex)
107	110 1011	6B	k	152	1001 1000	98	(hex)
108	110 1100	6C	l	153	1001 1001	99	(hex)
109	110 1101	6D	m	154	1001 1010	9A	(hex)
110	110 1110	6E	n	155	1001 1011	9B	(hex)
111	110 1111	6F	o	156	1001 1100	9C	(hex)
112	111 0000	70	p	157	1001 1101	9D	(hex)
113	111 0001	71	q	158	1001 1110	9E	(hex)
114	111 0010	72	r	159	1001 1111	9F	hex
115	111 0011	73	s	160	1010 0000	A0	(hex
116	111 0100	74	t	161	1010 0001	A1	｡
117	111 0101	75	u	162	1010 0010	A2	｢
118	111 0110	76	v	163	1010 0011	A3	｣
119	111 0111	77	w	164	1010 0100	A4	､
120	111 1000	78	x	165	1010 0101	A5	･
121	111 1001	79	y	166	1010 0110	A6	ヲ
122	111 1010	7A	z	167	1010 0111	A7	ァ
123	111 1011	7B	{	168	1010 1000	A8	ィ
124	111 1100	7C	¦	169	1010 1001	A9	ゥ
125	111 1101	7D	}	170	1010 1010	AA	ェ
126	111 1110	7E	~	171	1010 1011	AB	ォ
127	111 1111	7F	▨	172	1010 1100	AC	ャ
128	1000 0000	80	(hex)	173	1010 1101	AD	ュ
129	1000 0001	81	(hex)	174	1010 1110	AE	ョ
130	1000 0010	82	(hex)	175	1010 1111	AF	ッ
131	1000 0011	83	(hex)	176	1011 0000	B0	ｰ
132	1000 0100	84	(hex)	177	1011 0001	B1	ア
133	1000 0101	85	(hex)	178	1011 0010	B2	イ
134	1000 0110	86	(hex)	179	1011 0101	B3	ウ

JIS-8 Character Conversion Table (cont.)

Dec Value	Binary	Hex	Displayed Character	Dec Value	Binary	Hex	Displayed Character
180	1011 0100	B4	エ	218	1101 1010	DA	レ
181	1011 0101	B5	オ	219	1101 1011	DB	ロ
182	1011 0110	B6	カ	220	1101 1100	DC	ワ
183	1011 0111	B7	キ	221	1101 1101	DD	ン
184	1011 1000	B8	ク	222	1101 1110	DE	゛
185	1011 1001	B9	ケ	223	1101 1111	DF	゜
186	1011 1010	BA	コ	224	1110 0000	E0	hex
187	1011 1011	BB	サ	225	1110 0001	E1	hex
188	1011 1100	BC	シ	226	1110 0010	E2	hex
189	1011 1101	BD	ス	227	1110 0011	E3	hex
190	1011 1110	BE	セ	228	1110 0100	E4	hex
191	1011 1111	BF	ソ	229	1110 0101	E5	hex
192	1100 0000	C0	タ	230	1110 0110	E6	hex
193	1100 0001	C1	チ	231	1110 0111	E7	hex
194	1100 0010	C2	ツ	232	1110 1000	E8	hex
195	1100 0011	C3	テ	233	1110 1001	E9	hex
196	1100 0100	C4	ト	234	1110 1010	EA	hex
197	1100 0101	C5	ナ	235	1110 1011	EB	hex
198	1100 0110	C6	ニ	236	1110 1100	EC	hex
199	1100 0111	C7	ヌ	237	1110 1101	ED	hex
200	1100 1000	C8	ネ	238	1110 1110	EE	hex
201	1100 1001	C9	ノ	239	1110 1111	EF	hex
202	1100 1010	CA	ハ	240	1111 0000	F0	hex
203	1100 1011	CB	ヒ	241	1111 0001	F1	hex
204	1100 1100	CC	フ	242	1111 0010	F2	hex
205	1100 1101	CD	ヘ	243	1111 0011	F3	hex
206	1100 1110	CE	ホ	244	1111 0100	F4	hex
207	1100 1111	CF	マ	245	1111 0101	F5	hex
208	1101 0000	D0	ミ	246	1111 0110	F6	hex
209	1101 0001	D1	ム	247	1111 0111	F7	hex
210	1101 0010	D2	メ	248	1111 1000	F8	hex
211	1101 0011	D3	モ	249	1111 1001	F9	hex
212	1101 0100	D4	ヤ	250	1111 1010	FA	hex
213	1101 0101	D5	ユ	251	1111 1011	FB	hex
214	1101 0100	D6	ヨ	252	1111 1100	FC	hex
215	1101 0111	D7	ラ	253	1111 1101	FD	hex
216	1101 1000	D8	リ	254	1111 1110	FE	hex
217	1101 1001	D9	ル	255	1111 1111	FF	hex

EBCDIK Character Conversion Table

Dec Value	Binary	Hex	Displayed Character
0	0000 0000	00	NU
1	0000 0001	01	SH
2	0000 0000	02	SX
3	0000 0011	03	EX
4	0000 0100	04	PF
5	0000 0101	05	HT
6	0000 0110	06	LC
7	0000 0111	07	
8	0000 1000	08	hex
9	0000 1001	09	RF
10	0000 1010	0A	SM
11	0000 1011	0B	VT
12	0000 1100	0C	FF
13	0000 1101	0D	CR
14	0000 1110	0E	SO
15	0000 1111	0F	SI
16	0001 0000	10	DL
17	0001 0001	11	D1
18	0001 0010	12	D2
19	0001 0011	13	D3
20	0001 0100	14	RE
21	0001 0101	15	NL
22	0001 0110	16	BS
23	0001 0111	17	IL
24	0001 1000	18	CN
25	0001 1001	19	EM
26	0001 1010	1A	CC
27	0001 1011	1B	C1
28	0001 1100	1C	FS
29	0001 1101	1D	GS
30	0001 1110	1E	RS
31	0001 1111	1F	US
32	0010 0000	20	DS
33	0010 0001	21	SS
34	0010 0010	22	FS
35	0010 0011	23	hex
36	0010 0100	24	BP
37	0010 0101	25	LF
38	0010 0110	26	EB
39	0010 0111	27	EC
40	0010 1000	28	hex
41	0010 1001	29	hex
42	0010 1010	2A	SM
43	0010 1011	2B	C2
44	0010 1100	2C	hex

Dec Value	Binary	Hex	Displayed Character
45	0010 1101	2D	EQ
46	0010 1110	2E	AK
47	0010 1111	2F	BL
48	0011 0000	30	hex
49	0011 0001	31	hex
50	0011 0010	32	SY
51	0011 0011	33	hex
52	0011 0100	34	PN
53	0011 0101	35	RS
54	0011 0110	36	UC
55	0011 0111	37	ET
56	0011 1000	38	hex
57	0011 1001	39	hex
58	0011 1010	3A	hex
59	0011 1011	3B	C3
60	0011 1100	3C	D4
61	0011 1101	3D	NK
62	0011 1110	3E	hex
63	0011 1111	3F	SB
64	0100 0000	40	space
65	0100 0001	41	hex
66	0100 0010	42	hex
67	0100 0011	43	hex
68	0100 0100	44	hex
69	0100 0101	45	hex
70	0100 0110	46	ヲ
71	0100 0111	47	ァ
72	0100 1000	48	ィ
73	0100 1001	49	ゥ
74	0100 1010	4A	「
75	0100 1011	4B	.
76	0100 1100	4C	<
77	0100 1101	4D	
78	0100 1110	4E	+
79	0100 1111	4F	hex
80	0101 0000	50	&
81	0101 0001	51	ｴ
82	0101 0010	52	ｵ
83	0101 0011	53	ｬ
84	0101 0100	54	ｭ
85	0101 0101	55	ｮ
86	0101 0110	56	ｰ
87	0101 0111	57	hex
88	0101 1000	58	hex
89	0101 1001	59	hex

EBCDIK Character Conversion Table (cont.)

Dec Value	Binary	Hex	Displayed Character
90	0101 1010	5A	]
91	0101 1011	5B	¥
92	0101 1100	5C	*
93	0101 1101	5D	)
94	0101 1110	5E	;
95	0101 1111	5F	¬
96	0110 0000	60	-
97	0110 0001	61	/
98	0110 0010	62	(hex)
99	0110 0011	63	(hex)
100	0110 0100	64	(hex)
101	0110 0101	65	(hex)
102	0110 0110	66	(hex)
103	0110 0111	67	(hex)
104	0110 1000	68	(hex)
105	0110 1001	69	(hex)
106	0110 1010	6A	(hex)
107	0110 1011	6B	,
108	0110 1100	6C	%
109	0110 1101	6D	_
110	0110 1110	6E	>
111	0110 1111	6F	?
112	0111 0000	70	(hex)
113	0111 0001	71	(hex)
114	0111 0010	72	(hex)
115	0111 0011	73	(hex)
116	0111 0100	74	(hex)
117	0111 0101	75	(hex)
118	0111 0110	76	(hex)
119	0111 0111	77	(hex)
120	0111 1000	78	(hex)
121	0111 1001	79	`
122	0111 1010	7A	:
123	0111 1011	7B	#
124	0111 1100	7C	@
125	0111 1101	7D	'
126	0111 1110	7E	=
127	0111 1111	7F	"
128	1000 0000	80	(hex)
129	1000 0001	81	ア
130	1000 0010	82	イ
131	1000 0011	83	ウ
132	1000 0100	84	エ
133	1000 0101	85	オ
134	1000 0110	86	カ

Dec Value	Binary	Hex	Displayed Character
135	1000 0111	87	キ
136	1000 1000	88	ク
137	1000 1001	89	ケ
138	1000 1010	8A	コ
139	1000 1011	8B	hex
140	1000 1100	8C	サ
141	1000 1101	8D	シ
142	1000 1110	8E	ス
143	1000 1111	8F	セ
144	1001 0000	90	ソ
145	1001 0001	91	タ
146	1001 0010	92	チ
147	1001 0011	93	ツ
148	1001 0100	94	テ
149	1001 0101	95	ト
150	1001 0110	96	ナ
151	1001 0111	97	ニ
152	1001 1000	98	ヌ
153	1001 1001	99	ネ
154	1001 1010	9A	ノ
155	1001 1011	9B	hex
156	1001 1100	9C	hex
157	1001 1101	9D	ハ
158	1001 1110	9E	ヒ
159	1001 1111	9F	フ
160	1010 0000	A0	hex
161	1010 0001	A1	hex
162	1010 0010	A2	ヘ
163	1010 0011	A3	ホ
164	1010 0100	A4	マ
165	1010 0101	A5	ミ
166	1010 0110	A6	ム
167	1010 0111	A7	メ
168	1010 1000	A8	モ
169	1010 1001	A9	ヤ
170	1010 1010	AA	ユ
171	1010 1011	AB	hex
172	1010 1100	AC	ヨ
173	1010 1101	AD	ラ
174	1010 1110	AE	リ
175	1010 1111	AF	ル
176	1011 0000	B0	hex
177	1011 0001	B1	hex
178	1011 0010	B2	hex
179	1011 0101	B3	hex

EBCDIK Character Conversion Table (cont.)

Dec Value	Binary	Hex	Displayed Character
180	1011 0100	B4	‹hex›
181	1011 0101	B5	‹hex›
182	1011 0110	B6	‹hex›
183	1011 0111	B7	‹hex›
184	1011 1000	B8	‹hex›
185	1011 1001	B9	‹hex›
186	1011 1010	BA	レ
187	1011 1011	BB	ロ
188	1011 1100	BC	ワ
189	1011 1101	BD	ン
190	1011 1110	BE	゛
191	1011 1111	BF	゜
192	1100 0000	C0	‹hex
193	1100 0001	C1	A
194	1100 0010	C2	B
195	1100 0011	C3	C
196	1100 0100	C4	D
197	1100 0101	C5	E
198	1100 0110	C6	F
199	1100 0111	C7	G
200	1100 1000	C8	H
201	1100 1001	C9	I
202	1100 1010	CA	‹hex
203	1100 1011	CB	‹hex›
204	1100 1100	CC	‹hex›
205	1100 1101	CD	‹hex
206	1100 1110	CE	hex›
207	1100 1111	CF	‹hex
208	1101 0000	D0	hex
209	1101 0001	D1	J
210	1101 0010	D2	K
211	1101 0011	D3	L
212	1101 0100	D4	M
213	1101 0101	D5	N
214	1101 0100	D6	O
215	1101 0111	D7	P
216	1101 1000	D8	Q
217	1101 1001	D9	R
218	1101 1010	DA	hex
219	1101 1011	DB	hex
220	1101 1100	DC	hex
221	1101 1101	DD	hex
222	1101 1110	DE	hex
223	1101 1111	DF	hex
224	1110 0000	E0	$

Dec Value	Binary	Hex	Displayed Character
225	1110 0001	E1	hex›
226	1110 0010	E2	S
227	1110 0011	E3	T
228	1110 0100	E4	U
229	1110 0101	E5	V
230	1110 0110	E6	W
231	1110 0111	E7	X
232	1110 1000	E8	Y
233	1110 1001	E9	Z
234	1110 1010	EA	‹hex
235	1110 1011	EB	‹hex
236	1110 1100	EC	‹hex
237	1110 1101	ED	hex
238	1110 1110	EE	hex›
239	1110 1111	EF	‹hex
240	1111 0000	F0	0
241	1111 0001	F1	1
242	1111 0010	F2	2
243	1111 0011	F3	3
244	1111 0100	F4	4
245	1111 0101	F5	5
246	1111 0110	F6	6
247	1111 0111	F7	7
248	1111 1000	F8	8
249	1111 1001	F9	9
250	1111 1010	FA	‹hex
251	1111 1011	FB	‹hex
252	1111 1100	FC	hex
253	1111 1101	FD	‹hex
254	1111 1110	FE	hex
255	1111 1111	FF	hex

17

Async Terminal Emulator

The Asynchronous Terminal Emulator application lets you use the HP Model 4951C as an asynchronous terminal. After the application is loaded into the HP 4951C, a new menu is supplied which allows the instrument to be be configured as an asynchronous terminal. You can now send and receive information over a datacomm link asynchronously using the HP 4951C keyboard and display.

Equipment Supplied

The Async Terminal Emulator is included with the HP 4951C. A utility disc contains the Async Terminal Emulator application program. A second disc is provided so that you save a master copy as a backup. This chapter provides reference information on use of the Async Terminal Emulator.

Before making a working copy, read the section in this chapter titled "Getting Started". That section describes how to change the terminal default parameters before the application is stored to the working disc.

Applications

The Async Terminal Emulator application is very useful in the field service environment where you must now carry a protocol analyzer and a terminal. The application allows the HP 4951C to perform just like an asynchronous terminal so that you can send and receive electronic mail from the main office computer, check terminal problems, and configure intelligent devices without the need for a terminal.

Often field service technicians have the need to download daily trouble reports or read the day's computer mail while in the field. The Async Terminal Emulator application allows the office computer to be accessed from the field without the need for a separate terminal.

The Async Terminal Emulator application can also be used to pinpoint problems to a terminal. When a problem is suspected with an asynchronous terminal, the HP 4951C can replace the terminal to verify it as the faulty component.

Often intelligent devices must be configured with an asynchronous terminal. For example, some statistical multiplexers must be configured through an asynchronous terminal connected to them. The Async Terminal Emulator application is very useful for this purpose.

Features

DTE or DCE - The HP 4951C can be configured as a DTE (Data Terminal Equipment) or DCE (Data Communications Equipment) to avoid the need for a modem eliminator. A modem eliminator is a cable or connector which allows one DTE to transmit data directly to another DTE.

TWO HANDSHAKES - Two types of handshaking can be used: ENQ/ACK or NONE.

HDX or FDX - The terminal emulator can be used in either Half- or Full-duplex environments. (see page 17-13 for limits on the specific protocol handshake.

LOCAL ECHO - A local echo is available for systems in which the main office computer does not have remote echo.

BELL - A bell in the HP 4951C can be enabled or disabled to respond to a Bell character coming from the main office computer of the datacomm link.

BREAK - A Break key is available on a softkey to send a Break.

SEND, RECEIVE DATA VIEWED SIMULTANEOUSLY - Data sent and received are shown simultaneously on the HP 4951C display.

Specifications

Physical Interface	-	RS-232C/V.24
Data Codes	-	ASCII 7, ASCII 8
Parity	-	Odd, Even, None
Error Handling	-	None
Stop Bits	-	Transmit - 2 Receive - at least 1 bit
Data Rates	-	to 19.2 kbps

Getting Started

To load the application do the following:

1. Insert the HP 4951C PROTOCOL ANALYZER UTILTIY Disc into the disc drive of HP 4951C.

2. Press the 'MORE' key until <Mass Store> softkey appears.

3. Press the <Mass Store> softkey.

4. Place the cursor on "**TERMINAL**" and press <Load> -

   - OR -

   Use the keyboard and type in a file name such as "**TERMINAL**" for file name, if the application has been modified and given a new name and then press <Load>.

5. Press <Execute> softkey to load Async Terminal Emulator application program.

6. If the application loaded properly the HP 4951C shows the main Async Terminal Emulator display.

Terminal Setup

After the application is loaded, a new softkey appears in the top level menu (by pressing the MORE key) called <Term Setup>. This softkey accesses the Terminal Setup menu where the terminal parameters can be set. Shown below is the Terminal Setup menu with the parameters set to the default values.

Data code	*ASCII 8*
Parity	[None]
Bits/sec	[9600]
Mode	[DTE]
Handshake	[None]
Line terminator	[CR]
Local echo	[Off]
Bell	[Enabled]

* * - currently selected parameter
[ ] - inverse video

There are several system parameters which must be known before the Async Terminal Emulator can be used effectively. If these parameters are unknown they can usually be obtained from the data communications manager at the main office computer location. Wrong parameter choices will not result in damage to the system, only the inability to use the Async Terminal Emulator. To change the parameters, use the up and down cursor keys and then press the softkey to choose the appropriate system parameters.

Data Code Field

The softkey labels for the Data Code field are ASCII 7 and ASCII 8.

Parity Field

The softkey labels for the Parity field are None, Even, and Odd.

Bits/sec Field

The softkey labels for the Bits/sec field are as follows:

19200	9600	3600	1200	300
7200	4800	2400	600	110
3200	2000	1800	150	75
200	134.5	50		

Mode Field

The HP 4951C can be put into the DTE (Data Terminal Equipment) or DCE (Data Communication Equipment) mode. This removes the need for a modem eliminator.

Handshake Field

Two types of software handshakes are available. For more information on handshaking, refer to "Software Handshake" on page 17-11. The softkey labels for the Handshake field are as None, and ENQ/ACK.

The ENQ and ACK characters can be entered in Text or Hex.

Handshake	[ENQ/ACK]	
ENQ character	E_Q	entry
ACK character	A_K	

Line Terminator Field

The line terminator can be set at CR or CR/LF. Usually when the main office computer receives a CR it echoes back a CR/LF. The only time CR/LF need be chosen as the line terminator is when the CPU does not echo a CR/LF for a CR.

Local Echo Field

The HP 4951C can be configured with or without local echo. If the main computer in the system echoes back each character received (remote echo), the local echo should be turned Off or double characters will appear on the HP 4951C display.

Bell Field

When the system CPU sends a Bell character (BEL) the HP 4951C can be set to beep or disregard the character.

Operation

Pressing the <Execute> softkey (which is always the right-most softkey in the Terminal Setup menu) causes the HP 4951C to go into the terminal mode. The display is cleared and the cursor is placed in the "home" position. The "home" position is the top row, far left column. Two softkeys appear at the bottom of the display. The first softkey is the <CAPS LOCK> key. An "*" in this label indicates that the CAPS LOCK key is ON. To set the CAPS LOCK to OFF, press <CAP LOCK> softkey. The sixth softkey (softkeys two through five are not used) is the <BREAK> key. A BREAK is a signal used to interrupt computer operations. It is a space condition (logical 0). A break is sent as long as this softkey is held down. The shortest break possible is 6 milliseconds.

If local echo or remote echo (echo from main office computer) is in effect, characters appear on the display as they are typed. Pressing the left cursor key causes a backspace character (08H) to be transmitted and the cursor moves one space to the left on the HP 4951C display. Typing a CNTL H also results in a backspace. The terminal has a 14-line by 32-column display. When a line exceeds 32 columns it wraps around to the next line. When the display is full it scrolls up and a new line appears at the bottom.

When operating in the terminal mode, the HP 4951C functions as a "dumb" terminal, meaning that when a character is typed, it is immediately transmitted. The terminal is designed to receive one or more stop bits and to transmit two stop bits, making it compatible with all asynchronous devices.

Control characters can be sent by simultaneously holding down the CONTROL (CNTL) key and striking the desired character key. Hexadecimal characters cannot be entered. The terminal ignores most control characters and does not display them. Control characters that the terminal does respond to (but not displayed) are as follows:

ASCII	Hex	Response
BEL	07	Beep
BS	08	Backspace
HT	09	Tab one space
LF	0A	Line feed
CR	0D	Carriage return
ENQ	User Defn	Transmit ACK (User Defn. in ENQ/ACK)

Pressing EXIT in the terminal mode returns the HP 4951C to the Terminal Setup menu where you can change any of the parameters. Pressing the <Execute> softkey puts the HP 4951C back in the terminal mode of operation and the last terminal session appears on the display. This arrangement lets you switch to the Terminal Setup menu for a quick parameter change and then return to the terminal mode to continue the current terminal mode session. Pressing EXIT in the Terminal Setup menu returns the HP 4951C to the top level menu. All normal HP 4951C menus remain as they were before the terminal session was entered.

Making A Working Copy

If you are not familiar with the basic features of the HP 4951C, use the following procedure to copy the menu for a particular terminal application:

1. Load application from utility disc.

If you want to store a Terminal Setup menu with parameters other than the default parameters, follow steps 2 through 4. If not, go to step 5.

2. Press MORE until <Term Setup> softkey appears.

3. Press <Term Setup> softkey.

4. Change desired parameters.

5. Replace master disc in HP 4951C disc drive with blank formatted disc.

   Make sure the WRITE PROTECT TAB on the on blank disc is placed in the position to close the hole made for the tab in the disc; otherwise, a write protect error occurs when you attempt to store data.

6. Press EXIT to return to top level menu.

7. Press MORE until <Mass Store> softkey appears.

8. Press <Mass Store> softkey.

9. Press <Store> softkey.

10. Type in desired File Name. You may assign the file any name desired, e.g. 'Term' or 'T'. A suggestion might be the terminal manufacturer and or model number or a subset of each - e.g. HP2628.

11. Press cursor key. Press <Applic Progm> softkey to insure the correct File Type (application).

12. Press cursor key and type in a comment if desired. A comment is highly reccomended to allow the identification of files at a later date.

13. Press <Execute> softkey.

14. A working copy has now been made. Return the WRITE PROTECT TAB on disc to write protected position (push in direction to OPEN the hole in the disc for the write protect tab).

Hardware Handshake

The hardware handshake is the electronic handshake that occurs at the physical level of the communications link before data is transferred across the link.

When using the application in DTE mode, the DATA TERMINAL READY (DTR) and the REQUEST TO SEND (RTS) leads are set ON to ensure communications; however, the Async Terminal Emulator Application will transmit despite the state of DATA SET READY (DSR), CLEAR TO SEND (CTS), and CARRIER DETECT (CD) from the other device. When using the application in DCE mode, the DSR, CTS, and CD leads are set ON but the Async Terminal Emulator Application will transmit despite the state of DTR and RTS from the other device.

Software Handshake

The software handshake is different than the hardware handshake. It controls the flow of data between devices so that overflows do not occur. Although very few "dumb" terminals are designed to handle software handshaking, the Async Terminal Emulator Application supports ENQ/ACK and NONE.

ENQ/ACK Handshake

ENQ/ACK is initiated by the main office computer in the system. The computer is set up to send a specified number of characters (e.g., 80) followed by an ENQ character (usually 05H). When the terminal has processed all the transmitted characters and is ready to receive more, it sends an ACK character (usually 06H). To handle this type of software handshake choose ENQ/ACK in the Terminal Setup menu. When ENQ/ACK is selected for the handshake parameter, two new parameters appear which allow you to select the ENQ character and the ACK character. These characters are entered in Text or Hex using the keyboard.

"NONE" Handshake

If the system uses no handshake or some mode of handshaking other than ENQ/ACK, select NONE in the Terminal Setup menu. When the terminal is in the NONE handshake mode, all characters received are placed into an 8 kbyte buffer. If the buffer becomes full, the HP 4951C stops receiving data and an error message appears at the bottom of the display indicating the buffer has overflowed. A softkey labeled <Continue> also appears at the bottom of the display. Pressing this key resumes data flow into the buffer. The overflow message then disappears. If you expect a large file from the CPU, manual flow control should be used in order to view all of the data.

Manual Flow Control.

In the terminal mode of operation, if a main office computer downloads a file of data which is larger than that which can be displayed on the HP 4951C, you can manually control the data flow using the Xon and Xoff characters. To stop the flow of data, transmit an Xoff signal (usually press CNTL S). To resume the flow of data, transmit an Xon signal (usually press CNTL Q). This method of flow control can be used with either ENQ/ACK or NONE handshaking.

A

Error Messages

Application Denied

CAUSE This occurs when an attempt is made to load or rename an illegal application. This might be an application copied on another device other than another HP 4951C.

ACTION Check the application and insure that it is correct.

Application Not Copiable

CAUSE This occurs when an attempt is made to store an application that is not copiable.

ACTION Check the application and insure that it is not copy protected.

Bad Disc

CAUSE The disc will not format due to having too many bad tracks.

ACTION A disc having one or more bad tracks is considered not usable.

Baud rate > 19200 bps

CAUSE Auto Configure may work at higher rates.

ACTION Reduce the system bit rate to <= 192000 bps.

Buffer empty

CAUSE The slave buffer is empty.

ACTION Check the content of the slave buffer with examine data. Retry the upload.

Buffer Size Too Small

CAUSE The controller is trying to download too much.

ACTION Reduce the size of the buffer being sent over the remote link to the slave 4951C.

Checksum error

CAUSE Bit errors have occurred. A bad CRC check occurred when attempting to read or write a file on the disc. Data is assumed to be corrupt when this error occurs.

ACTION Retry the operation. Disc may no longer be useable. Try another disc to help isolate the problem.

Controller Error

CAUSE The disc controller is not working properly.

ACTION Run disc self test to verify disc controller error.

Conversion error: menus reset

CAUSE This might occur if the menus being transferred are invalid.

ACTION Check menu compatibility. Retry menu transfer.

Drive Error

CAUSE The disc drive is not working properly, a hardware failure has occurred.

ACTION Run disc self test to verify disc controller error.

Directory Full

CAUSE The directory on the disc is full, and no other files can be written onto the disc. The directory can contain eighty files maximum.

ACTION Reduce the number of file names.

Disc Full

CAUSE The disc is full of data and no more will fit. This error occurs during write operations.

ACTION You can "pack" the disc using the <Pack Disc> softkey to possibly make enough space for the new file to fit.

Disc not formatted

CAUSE The disc has not been formatted.

ACTION The disc must be formatted before you can use it in the HP 4951C.

Disc Out

CAUSE The disc is out at the beginning of a disc operation, or the disc is taken out during a disc operation.

ACTION Make sure a disc is properly installed in the disc drive. Press <Dir>.

Disc removed during a Read operation

CAUSE When you remove the disc during a load operation, the buffer data is invalid.

ACTION Use the EXIT key to exit. Try loading the data again.

Disc read error: buffer data invalid

CAUSE This may be caused by, checkrun error, a record not found, a corrupt file on disc, a broken disc controller, or by a worn out disc.

ACTION Use the EXIT key to exit. Try another disc to help isolate the problem.

Directory too large

CAUSE The disc has a directory that is too large. We format ten sectors for 80 entries for the directory.

ACTION Reduce the number of files by deleting un-needed files.

EOF error

CAUSE An attempt was made to read more records than exist in the file. The End Of File was found before the read completed.

ACTION RETRY, if it fails again - retry on a different disc. If the error persists, suspect a disc controller failure.

End of disc file

CAUSE When you specify a block number beyond the last block on disc.

ACTION Correct the block number specified so as to specify a block number on the disc.

End of valid data

CAUSE When you scroll to the end of buffer data.

ACTION Scroll backward.

File does not exist

CAUSE Attempt to load a file that does not exist or has been deleted.

ACTION Recheck the directory for the file name or use the <recover> function of mass store menu to try to replace the file into the directory so that it may be accessed.

File is not recoverable

CAUSE Attempt to recover a file that is not recoverable. Probably a file created on an instrument other than an HP 4951C.

ACTION Recheck the file and insure it's compatibility to the HP 4951C.

File name already exists

CAUSE Attempt to store a file with a name and type that already exists.

ACTION Recheck the name and/or type to insure either the name or the type is different from existing files.

File Not Compatible

CAUSE Attempt to load a file that is not compatible with the HP 4951. This file could have the correct type but perhaps might be an application not compatible with the HP 4951C.

ACTION Recheck the file and insure it's compatibility to the HP 4951C.

Framing error

CAUSE Could not find a "1" stop bit in an asynchronous protocol. This error may occur because a transmit clock (TC or ETC) is missing in a synchronous protocol. The HP 4951C assumes an asynchronous protocol, but cannot then find the stop bit.

ACTION Check transmit clock indicators on the pod. Check protoclo setup. Retry the transmission.

Improper format

CAUSE The disc format is not compatible with the HP 4951C for runtime use. The disc format is LIF but not formatted on a HP 4951C and will not work at runtime for writing to the disc.

ACTION Format the disc in/on a HP 4951C.

Invalid File Name

CAUSE Attempt to enter an invalid file name.

ACTION Correct the file name. Allowable characters are A - Z, numbers, and the underscore character. The file name must start with a capitol alpha-numeric character.

Invalid File Type

CAUSE Attempt to load of store a file with a file type that is not valid on a HP 4951C.

ACTION Correct the file type to match with a compatible file type on the HP 4951C.

Invalid Mon/Sim Menu

CAUSE This may occur if you enter "When DTE/DCE" without completing the trigger branching instruction.

ACTION Examine monitor/simulate menu for incorrect parameter. Correct the error and retry.

Issue ID request to enable slave

CAUSE Failure to issue ID request to enable slave.

ACTION You must always <Execute> this operation immediately after establishing phone communication in order to synchronize remote transfers.

Max Length

CAUSE This message appears if you attempt to specify more than 255 characters in a single string.

ACTION Reduce the number of characters in the string.

Max Strings

CAUSE Appears if the Monitor and Simulate Menus combined contain strings which have a total of more than 2000 characters.

ACTION Reduce the number of characters in the string.

Media Wear Protected

CAUSE The disc is write protected because of excess wear on the disc. This prevents you from writing on a disc surface that is marginal.

ACTION Use another disc and copy this to that new disc as soon as possible.

Menu Full

CAUSE Appears if the Monitor and Simulate Menus combined contain more than 143 steps.

ACTION Reduce the number of steps.

Menus incompatible with HP 4951C

CAUSE This might occur for certain menus created by a HP 4955A or HP 4953A.

ACTION It may be possible to modify the existing menu to run on the HP 4951C. Examine the menu for any illegal parameters, correct and retry.

Modem handshake fails

CAUSE The controller RTS, CTS handshaking has failed

ACTION Retry, while monitoring RTS & CTS line activity to help isolate the problem.

New name already exsits

CAUSE Attempt to rename a file with a name and type that already exsists.

ACTION Recheck the name and/or type to insure either the name or the type is different from existing files.

No application loaded

CAUSE Attempt to store an application when no application was loaded in the application portion of ram.

ACTION Load the application desired into the HP 4951C before trying to store it.

No data in buffer -- Use EXIT key to exit

CAUSE This occurs if the buffer is empty when you go to the Examine Data Menu.

ACTION Monitor On-Line, or load from the disc to fill the buffer.

No data in capture buffer

CAUSE This occurs if the buffer is empty when you try to store a menus & data file or a data file.

ACTION Monitor On-Line, or load from the disc to fill the buffer.

No disc drive

CAUSE This indicates that a monitor or simulate menu was attempted to be executed with a "Start Disc" command and a disc drive is either not installed or is malfunctioning.

ACTION Use the self test mode to insure proper disc operation and/or insure that a disc drive is installed.

No displayable data in buffer for the selected display format

CAUSE This indicates that the buffer contains non-displayable data, such as lead transitions.

ACTION Use Data & State display format to see the lead transitions.

No data in requested blks

CAUSE The controller has requested data from empty blocks.

ACTION Adjust the blocks requested.

No data present

CAUSE There is no line data.

ACTION Both data and idle conditions must be present.

No Idles

CAUSE There are insufficient idles on the line.

ACTION Both data and idles must be present. Asynchronous protocols must have a minimum of two idle characters between messages.

No pod attached

CAUSE The pod is not attached.

ACTION Be sure to turn off the power before connecting the interface pod.

No Sync Characters

CAUSE Could not find any of the sync characters listed on page 4-9.

ACTION Try to sync on idles to capture all the data on the line and then check the data with examine data menu for the presence of sync charaters.

Non LIF format

CAUSE The disc has been formatted, but the format is not the LIF format used by the HP 4951C.

ACTION Format the disc in/on a HP 4951C.

Nonstandard Baud Rate

CAUSE The bit rate is not within 5% of those listed on page 4-9.

ACTION Adjust bit rate of system the HP 4951C is attached to for monitoring/simulating.

No more highlights

CAUSE When you press the <Next Hilit> key and there are no more highlights.

ACTION View highlights again by returning to start of buffer (use <Spec Block>) and then <Next Hilit>.

Out of lock -- data fault

CAUSE The tester couldn't synchronize at the beginning of the test because of a wrong pattern, or the absence of data.

ACTION Modify the Setup Menu and/or insure data is being sent over the line.

Out of lock -- sync loss

CAUSE The tester lost synchronization during the test.

ACTION Check the set up for sync characters and try again.

Operation not valid for HP 4951C

CAUSE The operation is one that only an HP 4955A or HP 4953A can perform.

ACTION Amend operation to comply with HP 4951C capabilities.

Record Not Found

CAUSE A track or sector was not found during a disc operation which could indicate a corrupt format on the disc or a worn disc.

ACTION Re-try the read or write operation.

Single sided disc

CAUSE The disc has been formatted as a single-sided disc.

ACTION The HP 4951C uses a double-sided format specific to HP 4951C.

Seek error

CAUSE The disc controller can not find a location on the disc that it expects to find.

ACTION Retry the operation. Retry the operation on another disc. If the error persists, destroy the disk the failure occurred on and use another.

Start block# must = first

CAUSE The controller has not specified the first block in the slave buffer.

ACTION Note that the first block may not be "1" if the buffer data has been loaded from disc.

Start of valid data

CAUSE When you scroll to the beginning of buffer data.

ACTION Scroll forward.

Write Protected

CAUSE The disc "write protect" tab is in the "protect" position. The tab will not be visible and a physical hole will exist in that portion of the disc case.

ACTION To store information on a write protected disc, slide the protect tab to the opposite position.

B

Specifications

Radio Frequency Interference

HP guarantees the HP 4951C will comply with applicable EMI regulations while operating with all detachable probes, leads and cables disconnected.

The user is responsible for insuring that emissions from equipment operating with connected test probes/cables do not exceed the EMI limits at the border of their property.

Weight

Net: 5.9 kg. (13 lbs.)
Shipping: 12.2 kg. (27 lbs.)

Size

Height: 16 cm, width 27.9 cm, depth 34.3 cm. (6.3 x 11 x 13.5 in.)

Temperature (with media inserted)

Operating: 0°C to +50°C (+32°F to +131°F) **
Storage: -20°C to +75°C (-20°F to +167°F)

** The disc drive should only be operated from +5°C to +50°C (+41°F to +122°F) due to media limitations. The drive shouldn't be stored beyond 4°C to 53°C (39oF to 127oF at 8% to 90% humidity when media is inserted.

Power Requirements

100 to 240 Vac, -10% to +10%; 48 to 66 Hz single phase.
Typical less than 15 VA, maximum less than 30 VA.

Altitude

Operation to 15,000 ft.
Storage to 50,000 ft.

Operating Characteristics

Protocols

X.25, HDLC, SDLC (NRZI), BSC, and most character asynchronous or synchronous protocols.

Data Transfer Rates (bps)

50, 75, 100, 134.5, 150, 200, 300, 600, 1200, 1800, 2000, 2400, 3200, 3600, 4800, 7200, 9600, 12000, 14400, 16000, 19200, teletext 1200/75, and EXTERNAL up to 19200 full duplex for monitoring, simulation, triggering, and BERT tests.

Higher line utilization and/or the number of triggers specified will cause degradation of the data transfer rate at which the HP 4951C can operate.

The HP 4951C can capture a complete buffer full of data at line speeds up to 64 kbps. (Bit oriented protocols only).

Data Codes

ASCII, EBCDIC, Baudot, Six Bit Transcode, IPARS, and EBCD.

Mass Storage Memory

32 kbytes of RAM stores data characters, timing, and lead status information.

Optional disc drive: Up to 512 kbytes for storing data, timing information, menu configurations, and application programs. Write to disc: 9600 bps full duplex, 19200 bps half duplex.

Lead Status

The status of five control leads are stored for each interface. They are RTS, CTS, DTR, DSR, and CD for RS-232C/V.24, and CS, RS, RR, TR, and DM for RS-449.

Highlights

Highlight the last 63 triggers.

Character Framing

5, 6, 7, or 8 information bits, plus parity. For asynchronous systems select 1, 1.5, or 2 stop bits per character.

Error Checking

CRC-CCITT, CRC-16, CRC-12, CRC-6, LRC, and parity.

Triggers

63 triggers consisting of characters, errors, interface lead transitions, or timer values. All be simultaneously active up to 19200 bps.

Timers

Five timers, each of which has a maximum count of 65565 msec. Resolution 1 msec.

Counters

Five counters, each of which can be incremented up to 9999.

Keyboard

Full ASCII keyboard with six softkeys and cursor control.

Display

12.7 cm (5 in.) diagonal with 16 lines and 32 characters per line.

Display Formats

Five: DTE only, DCE only, DTE over DCE, Data and State, and Frame and Packet.

Send Strings

255 characters per string maximum, 1750 characters total.

Remote Capability

Over the RS-232C/V.24 link: transfer data, setups, and programs.

Self Test

Extensive self test and verification routines for isolating failures to a functional component group. Built-in signature analysis permits fault isolation to the component level.

Bit Error Rate Testing

Simultaneously measure bit errors, block errors, error seconds, and percent error free seconds.

Block Size: 63, 511, 1000, or 2047 bits.

Patterns: 63, 511, or 2047 bit pseudo random sequence.

Character Framing: Select 5, 6, 7, 8 bits per character and parity, or none (continuous). Select odd or even parity with character framing, or none with no framing.

Inject Errors: Inject single errors or bursts of errors.

Additional Characteristics

Auto-configuration of all setup parameters.

Auto-Load of applications programs by renaming them "autoapplic".

Battery maintained RAM for all setups, data, and menus.

Select **bit order** as LSB or MSB first and select **bit sense** as inverted or normal.

C

Accessories

Accessories Supplied

Asynchronous Terminal Emulator Software Package	
Power Cord	(See Appendix E)
Pod-Instrument Cable (for all pods)	HP 04951-61618
Operating Manual	HP 04951-90702
Getting Started	HP 04951-90715
Jumper Cable	HP 8120-4218
Y Jumper Cable	HP 8120-4219
Transportation Disc	HP 5060-7177

Interface pods, listed below, are not supplied and must be ordered separately.

Accessories Available

18174A	RS-449 Interface Pod
18177A	V.35 Interface Pod (to 19.2 Kbps.)
18179A	RS-232C/V.24 Interface Pod with Breakout Box and 3-state LEDs
18180A	Combination RS-232C/V.24 and RS-449 Interface Pod
18190A	Soft Vinyl Carrying Case
18192A	Soft vinyl carrying case for extra pods
18331D	Advance Protocol Analysis HP18331D (SNA, DDCMP, X.25)
18332D	"3270" Installation and Maintenance
18347A	HP 4951C Customer Training - One day - Intensive
92192A	Set of 10 blank discs
9211-1290	**Hard** transit case.

One of the cables listed below is included with the appropriate interface.

RS-232C/V.24 Y-Ribbon Cable	HP 18173-61602
RS-449 Y-Ribbon Cable	HP 18174-61601

Options

Option 002	Delete Integral Disc Drive
Option 003	Katakana (JIS 7, JIS 8, EBCDIK) datacodes
Option 101	Adds accessory 18174A
Option 102	Adds accessory 18180A
Option 103	Adds accessory 18179A
Option 105	HP 18177A, V.35 Interface Kit
Option 500	**Japanese** Operating Manual
Option 501	**French** Operating Manual
Option 502	**German** Operating Manual
Option 915	Service Manual
Option 916	Extra Operating Manual (HP P/N 04951-90702 and 04951-90715)
HP 4953A+N00	Software Notification Service
W30	Three Year extended hardware support. Provides two additional years of return-to-HP hardware support (for 2nd and 3rd years).

Interface Accessories

HP 18174A, HP 18178D, HP 18179A, HP 18177, HP 18180A and HP 18197A. Each interface is supplied with the appropriate 1.5 meter "Y" cable.

HP 18174A (RS-449) Interface

Nine dedicated activity indicators: SD - Send Data, RD - Receive Data, ST - Send Timing, RT - Receive Timing, RS - Request to Send, CS - Clear to Send, TR - Terminal Ready, DM - Data Mode, and RR - Receiver Ready.

Interface Activity Indicators: These turn on when the differential voltage is greater than 0.2 volts.

Weight: 0.6 kg (1.3 lb).

HP 18180A (Combination RS-232C/V.24 and RS-449 Interfaces).

Weight: 0.7 kg (1.5 lb).

HP 18179A (RS-232C/V.24) Interface

Full Breakout Box with 25 miniature switches provides access to all 25 conductors.

MARK/SPACE Monitor for user patching to any line.

Ten 3-state LEDs monitor primary interface signals at the source. DTE - Transmit Data, DCE - Receive Data, TC - Transmit Clock, RC - Receive Clock, DTR - Data Terminal Ready, DSR - Data Set Ready, RTS - Request to Send, CTS - Clear to Send, CD - Carrier Detect, and ETC - External Transmit Clock.

LED Indicators: Green -- Space (On). Red -- Mark (Off).

Input Voltage: +/- 25V as per EIA RS-232C or CCITT V.24 specifications.

Weight: 0.8 kg (1.8 lb).

OSI Level 2 and 3 Tables

D

Level 2: The Data Link Interface

CHARACTER ORIENTED PROTOCOLS: BSC

| SYN | SYN | SOH | Header | STX | Text | ITB / ETX / ETB | BCC | BCC |

BIT ORIENTED PROTOCOLS

| Flag | Address | Control | Data | FCS | FCS | Flag |

Flags: Flags (7E) act as frame delimiters

Address Field: Command frames contain receiving station's address. Response frames contain sending station's address.

Control Field: Identifies function and purpose of the frame. Contains commands, responses, and sequence numbers.

Information Field: Any number of bits, typically in multiples of 8 (octets).

FCS: Frame Checking Sequence for Error Detection.

TYPES OF BOP FRAMES (Indicated by the following control fields)

1. **Information (I) Frames:** For transferring information.

| N(R) | P/F | N(S) | 0 |

2. **Supervisory (S) Frames:** To acknowledge I frames, request re-transmission of I frames, and to communicate status (busy, ready).

Receive Ready (RR)

| N(R) | P/F | 0 0 | 0 1 |

Reject (REJ)

| N(R) | P/F | 1 0 | 0 1 |

Receive Not Ready (RNR)

| N(R) | P/F | 0 1 | 0 1 |

Selective Reject (SREJ)

| N(R) | P/F | 1 1 | 0 1 |

3. **Unnumbered (U) Frames:** To issue commands and responses.

| Type | P/F | Type | 1 1 |

UNNUMBERED FORMAT COMMANDS (P=Poll, F=Final)

Control Field Bits (msb lsb)	Mnemonic	Name
1 0 0 P 0 0 1 1	SNRM	Set Normal Response Mode
0 0 0 P 0 0 1 1	SARM	Set Asynchronous Response Mode
0 0 1 P 1 1 1 1	SABM	Set Asynchronous Balanced Mode
1 1 0 P 1 1 1 1	SNRME	Set Normal Response Mode Extended
0 1 0 P 1 1 1 1	SARME	Set Asynchronous Response Mode Extended
0 1 1 P 1 1 1 1	SABME	Set Asynchronous Balanced Mode Extended
0 0 0 P 0 1 1 1	SIM	Set Initialization Mode
0 1 0 P 0 0 1 1	DISC	Disconnect
0 0 0 P 0 0 1 1	UI	Unnumbered Information
0 0 1 P 0 0 1 1	UP	Unnumbered Poll
1 0 0 P 1 1 1 1	RSET	Reset
1 0 1 P 1 1 1 1	XID	Exchange Identification

UNNUMBERED FORMAT RESPONSES

0 1 1 F 0 0 1 1	UA	Unnumbered Acknowledgement
0 0 0 F 1 1 1 1	DM	Disconnected Mode
0 0 0 F 0 1 1 1	RIM	Request Initialization Mode
0 0 0 F 0 0 1 1	UI	Unnumbered Information
1 0 0 F 0 1 1 1	FRMR	Frame Reject
1 0 1 F 1 1 1 1	XID	Exchange Identification
0 1 0 F 0 0 1 1	RD	Request Disconnect

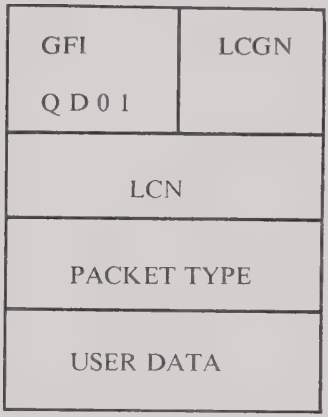
SAMPLE MONITOR MENU TRIGGERS ("x" = don't care)

When DTE	Trigger on data from the DTE
When DTE (flag) 0_1	Address (second byte)
When DTE (flag) 0_1 xxxxxxxx	Control Field, don't cares (3rd byte)
When DTE (flag) 0_1 xxxxxx11	U-Frame
When DTE (flag) 0_1 100x0011	Type of U-Frame = SNRM
When DTE (flag) 0_1 10010011	Poll bit set to 1
When DTE (flag) 0_3 xxxx0001	S-Frame
When DTE (flag) 0_3 10110001	S-Frame, Type=RR, N(R)=5, P/F=1
When DTE (flag) 0_3 00100010	I-Frame, N(R)=1, N(S)=1, P/F=0 (This is an I-Frame)

Level 3

PACKET CONSTRUCTION (MODULO 8)

msb lsb



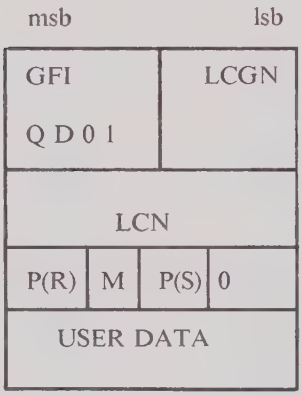
Packet Types RRR=N(R), SSS=N(S)

	msb lsb
Data	RRRMSSS0
Call Request	00001011
Call Accepted	00001111
Clear Request	00010011
Clear Confirmation	00010111
Interrupt	00100011
Interrupt Conf.	00100111
Receive Ready	RRR00001
Receive Not Ready	RRR00101
Reject	RRR01001
Reset Request	00011011
Reset Confirmation	00011111
Restart Request	11111011
Restart Conf.	11111111
Diagnostic	11110001

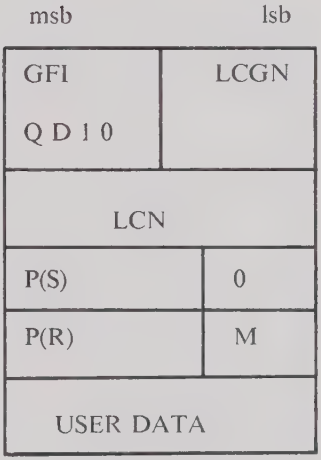
LCGN = Logical Channel Group Number
LCN = Logical Channel Number
Logical Channel Identifier = LCN + LCGN
P(R) = Next Receive Packet Expected
P(S) = Packet Send Sequence Number
M-bit = More Data Bit
Q-bit = Data Qualifier Bit
D-bit = Delivery Confirmation Bit

DATA PACKETS

MODULO 8



MODULO 128



CALL REQUEST/ INCOMING CALL PACKET

GFI	LCGN	Octet 1
LCN		Octet 2
0 0 0 0 1 0 1 1		Octet 3
Calling DTE Address Length	Called DTE Address Length	Octet 4
Called DTE Address		Octet 5
Calling DTE Address		Octet 6
0 0	Facility Field Length	Octet 7
Facility Codes and Parameters		Octet 8
Call User Data		

CALL ACCEPTED/ CALL CONNECTED PACKET

GFI	LCGN
LCN	
0 0 0 0 1 1 1 1	
Calling DTE Address Length	Called DTE Address Length
Called DTE Address	
Calling DTE Address	
0 0	Facility Field Length
Facilities	

E

Service Information

WARNING

Before connecting the HP 4951C to any line voltage, be sure the correct fuse is installed. Damage to the instrument may occur if the wrong fuse is installed. See the next page for procedures to replace the fuse.

WARNING

Before connecting the HP 4951C to any line voltage, the protective earth terminal of the instrument must be connected to the protective conductor of the line power cable. The line plug must be inserted in an outlet provided with a protective earth contact. The protective conductor must not be negated by the use of an extension cord without a protective grounding conductor. Grounding one conductor of a two-conductor outlet does not provide an instrument ground.

Power Cable

The HP 4951C power cable has three wires. When connected to an appropriate power receptacle, this cable grounds the instrument chassis. The type of power cable shipped with each instrument depends on the country of destination (see Table E-1). If the appropriate power cable is not included with the instrument, notify the nearest Hewlett-Packard Sales and Service office for a replacement.

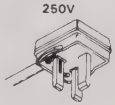
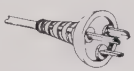
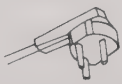
Line Voltage Selection

The line voltage selector is not available on the HP 4951C as the line voltage is not selectable.

Changing Fuses

The fuse is located behind the same back panel cover as the voltage selector cam. The fuse (HP #2110-0758) is a Time Delay fuse rated at .6A, 250V. To change the fuse:

1. Unplug the instrument and remove the line cord from the instrument.
2. Insert a small screwdriver into the slot at the top of the cover. Pry out the cover from the top.
3. Pull out the light gray fuse holder located under the voltage selector cam. Replace the fuse.
4. Re-insert the fuse holder with the arrow facing in the same direction as the two arrows on the cover.
5. Close the cover. Make sure the desired voltage is still visible in the window.

Plug Type	Cable HP Part Number	C D	Plug Description	Cable Length (inches)	Cable Color	For Use In Country
250V 	8120-1351 8120-1703	0 6	Straight *BS1363A 90°	90 90	Mint Gray Mint Gray	United Kingdom Cyprus, Nigeria Rhodesia, Singapore
250V 	8120 1369 8120-0696	0 4	Straight *NZSS198/ASC112 90°	79 87	Gray Gray	Australia New Zealand
250V	8120-1689 8120 1692	7 2	Straight *CEE7-Y11 90°	79 79	Mint Gray Mint Gray	East and West Europe, Saudi Arabia, Egypt So Africa India unpolarized in many nations
125V	8120-1348 8120 1398 8120-1754 8120-1378 8120-1521 8120-1676	5 5 7 1 6 2	Straight *NEMA5 15P 90° Straight *NEMA5-15P Straight *NEMA5-15P 90° Straight *NEMA5-15P	80 80 36 80 80 36	Black Black Black Jade Gray Jade Gray Jade Gray	United States, Canada Japan 100V or 200V Mexico Philippines Taiwan
250V	8120-2104	3	Straight *SEV1011 1959 24507 Type 12	79	Gray	Switzerland
250V	8120-0698	6	Straight *NEMA6-15P			United States Canada
220V	8120-1957 8120-2956	2 3	Straight *DHCK 107 90°	79 79	Gray Gray	Denmark
250V	8120-1860	6	Straight *CEE22-VI Systems Cabinet use			
250V 	8120-4600 8120-4211	8 7	Straight BS 546/SABS 164 90°	98 98	Black Black	So Africa India

*Part number shown for plug is industry identifier for plug only. Number shown for cable is HP Part Number for complete cable including plug.
E = Earth Ground, L = Line, N = Neutral

Table E-1. Power Cable Part Numbers

Adjustments

There are no operator adjustments for the HP 4951C. Any internal adjustments must be made by a qualified service person.

Performance Verification

Every time you turn the instrument on, self tests are automatically performed. These tests are completed in about 10 seconds. When the self tests are complete, the Top Level Menu is displayed. If the instrument comes up in the Top Level Menu, functional operation of 95% of the analyzer is verified. If there is a failure, the instrument does not come up in the Top Level Menu; instead it displays the failures that occurred during the self-test sequence.

The automatic turn-on self test checks everything in the analyzer except the following:

1. Keyboard. Use the keyboard test on page E-7.
2. Disc drive. Use the disc I/O test on page E-5.
3. Interface pod. Use the interface pod test on page E-8.

Disc I/O Test

Disc controller and drive failures are not displayed after the automatic self test. However, if files can be loaded and stored correctly, the proper functioning of the disc mechanism is verified. To detect a disc failure, merely store data or menus onto disc, press <Reset> to re-initialize the menus and clear memory, and then load the same file back into the instrument. The menus and data should be the same as when they were stored. A typical procedure would be like the following two checks.

Disc Drive Check

1. Insert a blank disc into the disc slot.
2. Press <Mass Store> on the Top Level Menu
3. You should be using a blank disc, or one that does not contain files you wish to keep. In the mass store menu, press <Format> and then <Execute>.
4. The disc should initialize properly.

Disc Read/Write Check

To check the disc I/O circuits, modify one of the menus, store the menus to disc, re-initialize the menus, and then load the menus back into the instrument. In this example, the simulate menu is modified.

1. In the simulate menu, press <DTE> and then <Send>. Type in some message, such as "The quick brown fox jumped over the lazy dog". Press EXIT to return to the Top Level Menu.

2. In the mass store menu, press <Format> and then <Execute>. Do not initialize the disc if it contains files you wish to keep.

3. In the mass store menu, press <Store>, type in a file name, and select <Menus> for the file type. Press <Execute>.

4. Once the menus are stored on disc, press <Reset> on the Top Level Menu to erase your previous simulate menu entries.

5. In the mass store menu, press <Load>, type in the file name you used when storing, and press <Execute>.

6. The simulate menu should contain your previous entries.

Keyboard Test

The keyboard test verifies that the HP 4951C correctly identifies each key pressed.

Setup

1. Turn on the HP 4951C
2. Press MORE
3. Press the <Self Test> softkey in the Top Level Menu.
4. Press <KBD Test>.

Procedure

1. Press any key on the keyboard.
2. The display should read: LAST KEY PRESSED: "(name of key is displayed)".

   Note: The RETURN key effectively performs the same operation as "cursor down". When the RETURN key is pressed, CURSOR DOWN is displayed.

3. Press EXIT to end the test and display the self-test menu.

Interface Pod Test

This test checks the DLC (data link controller), the interface cable from the instrument to the pod, and the interface pod itself. It does not check the LCD (or LED) indicators and their drivers.

Setup

1. Press MORE in the Top Level Menu.
2. Press the <Self Test> softkey.
3. Press <Ext DLC>.

Procedure

When the <Ext DLC> softkey is pressed, the Interface Pod test is automatically performed. If the test passes, then "DLC Test Passed" is displayed. Otherwise one of the following messages appears:

No pod attached
DTE failed
DCE failed

Press EXIT to return to the Self Test Menu.

Display Test

Press <Self Test> in the Top Level Menu. Select <CRT Tests> and then <Test Ptrn>. The test pattern should look like the following:

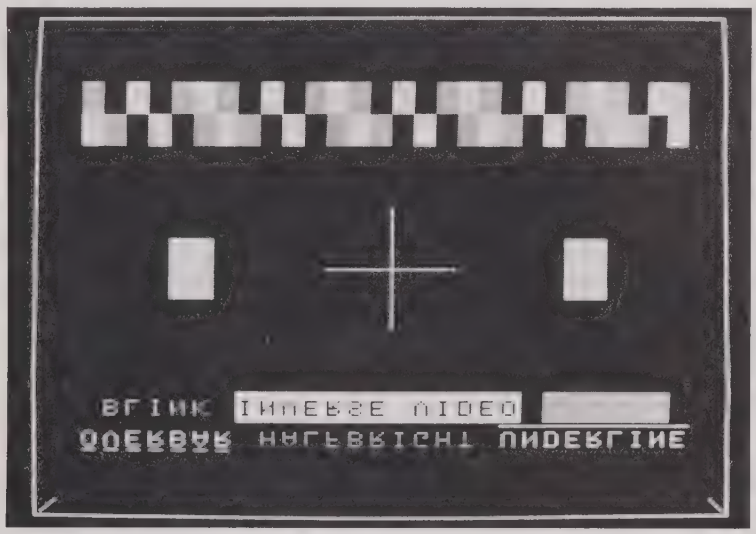


Figure E-1. Display Test Pattern

Packaging

If the instrument is returned to Hewlett-Packard for service, complete one of the blue repair tags located in the pouch and attach it to the instrument.

CAUTION

Always install the transportation disc in the disc drive when transporting or shipping the HP 4951C.

Original Packaging

Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for service, attach a tag indicating the type of service required, return address, model number, and full serial number. Mark the container FRAGILE to ensure careful handling. In correspondence, refer to the instrument by model number and full serial number.

Other Packaging

Wrap the instrument in heavy paper or plastic. Use a strong shipping container: a double-walled carton made of 350-pound test material is suitable. Use a layer of shock-absorbing material 70-to 100mm (3 to 4 inches) thick around the sides of the instrument to provide firm cushioning and to prevent movement inside the container. Seal the container securely. Mark shipping container FRAGILE to ensure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

F

External Video Output

The external video output is located on the rear panel of the HP 4951C. It is utilized for displaying the internal CRT monitor on an external monitor.

What is RS-170?

This strange sounding specification is really the electrical characteristic for the video signal on monochrome video monitors. The HP 4951C utilizes this specification to display the internal CRT monitor on an external monitor. An example monitor is the HP 82913A which utilizes this standard.

RS-170 specifies the following: 525 lines per frame, 60 Hz refresh rate, a horizontal scan rate of 15.75 KHz.

Useage

The HP 4951C does not work well with standard television monitors. The reason for this is that standard television monitors are designed to overscan the picture/frame displayed. This means that standard television monitors are not designed to display the **edges** of the frame received (approximately 10% of the frame is not shown). The HP 4951C does display 100% of the frame and therefore the frame displayed on a standard television **would not show** the 10% of the edges of the frame shown on the internal HP 4951C monitor screen.
The physical connector on the back of the HP4951C is a 75 ohm BNC type connector.

Recommended Video Monitors

Europe	82913A opt. 1	12" screen	& cable	5061-6533
U.S.	82913A	12" screen	& cable	8120-4703

G

Data Code Tables

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Baudot Character Conversion Table	G-11
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IPARS Character Conversion Table	G-15

ASCII Character Conversion Table

Dec Value	Binary	Hex	Displayed Character	Keyboard Mnemonic	Description
0	000 0000	00	NU	NUL	Null
1	000 0001	01	SH	SOH	Start of Header
2	000 0010	02	SX	STX	Start of Text
3	000 0011	03	EX	ETX	End of Text
4	000 0100	04	ET	EOT	End of Transmission
5	000 0101	05	EQ	ENQ	Enquiry
6	000 0110	06	AK	ACK	Positive Acknowledge
7	000 0111	07	BL	BEL	Bell
8	000 1000	08	BS	BS	Back Space
9	000 1001	09	HT	HT	Horizontal Tab
10	000 1010	0A	LF	LF	Line Feed
11	000 1011	0B	VT	VT	Vertical Tab
12	000 1100	0C	FF	FF	Form Feed
13	000 1101	0D	CR	CR	Carriage Return
14	000 1110	0E	SO	SO	Shift Out
15	000 1111	0F	SI	SI	Shift In
16	001 0000	10	DL	DLE	Data Link Escape
17	001 0001	11	D1	DC1	Device Control 1
18	001 0010	12	D2	DC2	Device Control 2
19	001 0011	13	D3	DC3	Device Control 3
20	001 0100	14	D4	DC4	Device Control 4
21	001 0101	15	NK	NAK	Negative Acknowledge
22	001 0110	16	SY	SYN	Synchronous Idle
23	001 0111	17	EB	ETB	End of Transmission Block
24	001 1000	18	CN	CAN	Cancel
25	001 1001	19	EM	EM	End of Medium
26	001 1010	1A	SB	SUB	Substitute
27	001 1011	1B	EC	ESC	Escape
28	001 1100	1C	FS	FS	File Separator
29	001 1101	1D	GS	GS	Group Separator
30	001 1110	1E	RS	RS	Record Separator
31	001 1111	1F	US	US	Unit Separator
32	010 0000	20	(space		
33	010 0001	21	!		
34	010 0010	22	"		
35	010 0011	23	#		
36	010 0100	24	$		
37	010 0101	25	%		
38	010 0110	26	&		
39	010 0111	27	'		
40	010 1000	28			
41	010 1001	29			
42	010 1010	2A	*		
43	010 1011	2B	+		
44	010 1100	2C	,		

ASCII Character Conversion Table (Cont'd)

Dec Value	Binary	Hex	Displayed Character	Keyboard Mnemonic	Description
45	010 1101	2D	-		
46	010 1110	2E	.		
47	010 1111	2F	/		
48	011 0000	30	0		
49	011 0001	31	1		
50	011 0010	32	2		
51	011 0011	33	3		
52	011 0100	34	4		
53	011 0101	35	5		
54	011 0110	36	6		
55	011 0111	37	7		
56	011 1000	38	8		
57	011 1001	39	9		
58	011 1010	3A	:		
59	011 1011	3B	;		
60	011 1100	3C	<		
61	011 1101	3D	=		
62	011 1110	3E	>		
63	011 1111	3F	?		
64	100 0000	40	@		
65	100 0001	41	A		
66	100 0010	42	B		
67	100 0011	43	C		
68	100 0100	44	D		
69	100 0101	45	E		
70	100 0110	46	F		
71	100 0111	47	G		
72	100 1000	48	H		
73	100 1001	49	I		
74	100 1010	4A	J		
75	100 1011	4B	K		
76	100 1100	4C	L		
77	100 1101	4D	M		
78	100 1110	4E	N		
79	100 1111	4F	O		
80	101 0000	50	P		
81	101 0001	51	Q		
82	101 0010	52	R		
83	101 0011	53	S		
84	101 0100	54	T		
85	101 0101	55	U		
86	101 0110	56	V		
87	101 0111	57	W		
88	101 1000	58	X		
89	101 1001	59	Y		

ASCII Character Conversion Table (Cont'd)

Dec Value	Binary	Hex	Displayed Character	Keyboard Mnemonic	Description
90	101 1010	5A	Z		
91	101 1011	5B	[		
92	101 1100	5C	\		
93	101 1101	5D	]		
94	101 1110	5E	^		
95	101 1111	5F	_		
96	110 0000	60	`		
97	110 0001	61	a		
98	110 0010	62	b		
99	110 0011	63	c		
100	110 0100	64	d		
101	110 0101	65	e		
102	110 0110	66	f		
103	110 0111	67	g		
104	110 1000	68	h		
105	110 1001	69	i		
106	110 1010	6A	j		
107	110 1011	6B	k		
108	110 1100	6C	l		
109	110 1101	6D	m		
110	110 1110	6E	n		
111	110 1111	6F	o		
112	111 0000	70	p		
113	111 0001	71	q		
114	111 0010	72	r		
115	111 0011	73	s		
116	111 0100	74	t		
117	111 0101	75	u		
118	111 0110	76	v		
119	111 0111	77	w		
120	111 1000	78	x		
121	111 1001	79	y		
122	111 1010	7A	z		
123	111 1011	7B	{		
124	111 1100	7C	¦		
125	111 1101	7D	}		
126	111 1110	7E	~		
127	111 1111	7F		DEL	Delete

EBCDIC Character Conversion Table

Dec Value	Binary	Hex	Displayed Character	Standard Mnemonic	Keyboard Entry If Other Than Standard	Description
0	0000 0000	00	NU	NUL		Null
1	0000 0001	01	SH	SOH		Start of Header
2	0000 0000	02	SX	STX		Start of Text
3	0000 0011	03	EX	ETX		End of Text
4	0000 0100	04	PF	PF	(hex)	Punch Off
5	0000 0101	05	HT	HT		Horizontal Tab
6	0000 0110	06	LC	LC	(hex)	Lower Case
7	0000 0111	07		DEL		Delete
8	0000 1000	08	(hex)			
9	0000 1001	09	RF	RLF	(hex)	
10	0000 1010	0A	SM	SMM	(hex)	Start Manual Message
11	0000 1011	0B	VT	VT		Vertical Tab
12	0000 1100	0C	FF	FF		Form Feed
13	0000 1101	0D	CR	CR		Carriage Return
14	0000 1110	0E	SO	SO		Shift Out
15	0000 1111	0F	SI	SI		Shift In
16	0001 0000	10	DL	DLE		Data Link Escape
17	0001 0001	11	D1	DC1		Device Control 1
18	0001 0010	12	D2	DC2		Device Control 2
19	0001 0011	13	D3	DC3		Device Control 3
20	0001 0100	14	RE	RES	(hex)	Restore
21	0001 0101	15	NL	NL	(hex)	New Line
22	0001 0110	16	BS	BS		Back Space
23	0001 0111	17	IL	IL	(hex)	Idle
24	0001 1000	18	CN	CAN		Cancel
25	0001 1001	19	EM	EM		End of Medium
26	0001 1010	1A	CC	CC	(hex)	Cursor Control
27	0001 1011	1B	C1	CU1	(hex	
28	0001 1100	1C	FS	IFS	FS	Information File Separator
29	0001 1101	1D	GS	IGS	GS	Information Group Separator
30	0001 1110	1E	RS	IRS	RS	Information Record Separator
31	0001 1111	1F	US	IUS	US	Information Unit Separator
32	0010 0000	20	DS	DS	(hex)	Digit Select
33	0010 0001	21	SS	SOS	(hex)	Start of Significance
34	0010 0010	22	FS	FS	(hex)	Field Separator
35	0010 0011	23	(hex			
36	0010 0100	24	BP	BYP	(hex)	Bypass
37	0010 0101	25	LF	LF		Line Feed
38	0010 0110	26	EB	ETB		End of Transmission Block
39	0010 0111	27	EC	ESC		Escape
40	0010 1000	28	(hex			
41	0010 1001	29	(hex			
42	0010 1010	2A	SM	SM	(hex)	Set Mode
43	0010 1011	2B	C2	CU2	(hex	
44	0010 1100	2C	(hex			

EBCDIC Character Conversion Table (Cont'd)

Dec Value	Binary	Hex	Displayed Character	Standard Mnemonic	Keyboard Entry If Other Than Standard	Description
45	0010 1101	2D	EQ	ENQ		Enquiry
46	0010 1110	2E	AK	ACK		Positive Acknowledge
47	0010 1111	2F	BL	BEL		Bell
48	0011 0000	30	(hex)			
49	0011 0001	31	(hex)			
50	0011 0010	32	SY	SYN		Synchronous Idle
51	0011 0011	33	(hex)			
52	0011 0100	34	PN	PN	(hex)	Punch On
53	0011 0101	35	RS	RS	(hex)	Reader Stop
54	0011 0110	36	UC	UC	(hex)	Upper Case
55	0011 0111	37	ET	EOT		End of Transmission
56	0011 1000	38	(hex)			
57	0011 1001	39	(hex)			
58	0011 1010	3A	(hex)			
59	0011 1011	3B	C3	CU3	(hex)	
60	0011 1100	3C	D4	DC4		Device Control 4
61	0011 1101	3D	NK	NAK		Negative Acknowledge
62	0011 1110	3E	(hex)			
63	0011 1111	3F	SB	SUB		Substitute
64	0100 0000	40	(space)			
65	0100 0001	41	(hex)			
66	0100 0010	42	(hex)			
67	0100 0011	43	(hex)			
68	0100 0100	44	(hex)			
69	0100 0101	45	(hex)			
70	0100 0110	46	(hex)			
71	0100 0111	47	(hex)			
72	0100 1000	48	(hex)			
73	0100 1001	49	(hex)			
74	0100 1010	4A	¢		[	
75	0100 1011	4B	.			
76	0100 1100	4C	<			
77	0100 1101	4D	(			
78	0100 1110	4E	+			
79	0100 1111	4F	!		]	
80	0101 0000	50	&			
81	0101 0001	51	(hex)			
82	0101 0010	52	(hex)			
83	0101 0011	53	(hex)			
84	0101 0100	54	hex)			
85	0101 0101	55	(hex)			
86	0101 0110	56	(hex)			
87	0101 0111	57	hex)			
88	0101 1000	58	hex			
89	0101 1001	59	hex)			

EBCDIC Character Conversion Table (Cont'd)

Dec Value	Binary	Hex	Displayed Character	Standard Mnemonic	Keyboard Entry If Other Than Standard	Description
90	0101 1010	5A	!			
91	0101 1011	5B	$			
92	0101 1100	5C	*			
93	0101 1101	5D	)			
94	0101 1110	5E	;			
95	0101 1111	5F	¬		^	
96	0110 0000	60	-			
97	0110 0001	61	/			
98	0110 0010	62	(hex)			
99	0110 0011	63	(hex)			
100	0110 0100	64	(hex)			
101	0110 0101	65	(hex)			
102	0110 0110	66	(hex)			
103	0110 0111	67	(hex)			
104	0110 1000	68	(hex)			
105	0110 1001	69	(hex)			
106	0110 1010	6A	¦			
107	0110 1011	6B	,			
108	0110 1100	6C	%			
109	0110 1101	6D	_			
110	0110 1110	6E	>			
111	0110 1111	6F	?			
112	0111 0000	70	(hex)			
113	0111 0001	71	(hex)			
114	0111 0010	72	(hex)			
115	0111 0011	73	(hex)			
116	0111 0100	74	(hex)			
117	0111 0101	75	(hex)			
118	0111 0110	76	(hex)			
119	0111 0111	77	(hex)			
120	0111 1000	78	(hex)			
121	0111 1001	79	'			
122	0111 1010	7A	:			
123	0111 1011	7B	#			
124	0111 1100	7C	@			
125	0111 1101	7D	'			
126	0111 1110	7E	=			
127	0111 1111	7F	"			
128	1000 0000	80	(hex)			
129	1000 0001	81	a			
130	1000 0010	82	b			
131	1000 0011	83	c			
132	1000 0100	84	d			
133	1000 0101	85	e			
134	1000 0110	86	f			

EBCDIC Character Conversion Table (Cont'd)

Dec Value	Binary	Hex	Displayed Character	Standard Mnemonic	Keyboard Entry If Other Than Standard	Description
135	1000 0111	87	g			
136	1000 1000	88	h			
137	1000 1001	89	i			
138	1000 1010	8A	hex			
139	1000 1011	8B	hex			
140	1000 1100	8C	hex			
141	1000 1101	8D	hex			
142	1000 1110	8E	hex			
143	1000 1111	8F	hex			
144	1001 0000	90	hex			
145	1001 0001	91	j			
146	1001 0010	92	k			
147	1001 0011	93	l			
148	1001 0100	94	m			
149	1001 0101	95	n			
150	1001 0110	96	o			
151	1001 0111	97	p			
152	1001 1000	98	q			
153	1001 1001	99	r			
154	1001 1010	9A	hex			
155	1001 1011	9B	hex			
156	1001 1100	9C	hex			
157	1001 1101	9D	hex			
158	1001 1110	9E	hex			
159	1001 1111	9F	hex			
160	1010 0000	A0	hex			
161	1010 0001	A1	~			
162	1010 0010	A2	s			
163	1010 0011	A3	t			
164	1010 0100	A4	u			
165	1010 0101	A5	v			
166	1010 0110	A6	w			
167	1010 0111	A7	x			
168	1010 1000	A8	y			
169	1010 1001	A9	z			
170	1010 1010	AA	hex			
171	1010 1011	AB	hex			
172	1010 1100	AC	hex			
173	1010 1101	AD	hex			
174	1010 1110	AE	hex			
175	1010 1111	AF	hex			
176	1011 0000	B0	hex			
177	1011 0001	B1	hex			
178	1011 0010	B2	hex			
179	1011 0101	B3	hex			

EBCDIC Character Conversion Table (Cont'd)

Dec Value	Binary	Hex	Displayed Character	Standard Mnemonic	Keyboard Entry If Other Than Standard	Description
180	1011 0100	B4	‹hex›			
181	1011 0101	B5	‹hex›			
182	1011 0110	B6	‹hex›			
183	1011 0111	B7	‹hex›			
184	1011 1000	B8	‹hex›			
185	1011 1001	B9	‹hex›			
186	1011 1010	BA	‹hex›			
187	1011 1011	BB	‹hex›			
188	1011 1100	BC	‹hex			
189	1011 1101	BD	‹hex›			
190	1011 1110	BE	‹hex›			
191	1011 1111	BF	‹hex›			
192	1100 0000	C0	{			
193	1100 0001	C1	A			
194	1100 0010	C2	B			
195	1100 0011	C3	C			
196	1100 0100	C4	D			
197	1100 0101	C5	E			
198	1100 0110	C6	F			
199	1100 0111	C7	G			
200	1100 1000	C8	H			
201	1100 1001	C9	I			
202	1100 1010	CA	‹hex›			
203	1100 1011	CB	hex			
204	1100 1100	CC	⌠			
205	1100 1101	CD	‹hex			
206	1100 1110	CE	⍋			
207	1100 1111	CF	hex›			
208	1101 0000	D0	}			
209	1101 0001	D1	J			
210	1101 0010	D2	K			
211	1101 0011	D3	L			
212	1101 0100	D4	M			
213	1101 0101	D5	N			
214	1101 0100	D6	O			
215	1101 0111	D7	P			
216	1101 1000	D8	Q			
217	1101 1001	D9	R			
218	1101 1010	DA	hex			
219	1101 1011	DB	hex			
220	1101 1100	DC	hex			
221	1101 1101	DD	hex			
222	1101 1110	DE	hex			
223	1101 1111	DF	hex			
224	1110 0000	E0				

*Use CNTL Key in conjunction with symbol

EBCDIC Character Conversion Table (Cont'd)

Dec Value	Binary	Hex	Displayed Character	Standard Mnemonic	Keyboard Entry If Other Than Standard	Description
225	1110 0001	E1	(hex)			
226	1110 0010	E2	S			
227	1110 0011	E3	T			
228	1110 0100	E4	U			
229	1110 0101	E5	V			
230	1110 0110	E6	W			
231	1110 0111	E7	X			
232	1110 1000	E8	Y			
233	1110 1001	E9	Z			
234	1110 1010	EA	(hex)			
235	1110 1011	EB	(hex)			
236	1110 1100	EC	⌐		-*	
237	1110 1101	ED	(hex)			
238	1110 1110	EE	(hex)			
239	1110 1111	EF	(hex)			
240	1111 0000	F0	0			
241	1111 0001	F1	1			
242	1111 0010	F2	2			
243	1111 0011	F3	3			
244	1111 0100	F4	4			
245	1111 0101	F5	5			
246	1111 0110	F6	6			
247	1111 0111	F7	7			
248	1111 1000	F8	8			
249	1111 1001	F9	9			
250	1111 1010	FA	|		/*	
251	1111 1011	FB	(hex)			
252	1111 1100	FC	(hex)			
253	1111 1101	FD	(hex			
254	1111 1110	FE	(hex)			
255	1111 1111	FF	(hex)			

*Use CNTL Key in conjunction with symbol.

Baudot Character Conversion Table

Dec Value	Binary	Hex	Unshifted Characters (letters)	Shifted Characters (figures)
0	0 0000	00	NU	NU
1	0 0001	01	E	3
2	0 0010	02	LF	LF
3	0 0011	03	A	-
4	0 0100	04	(space)	(space)
5	0 0101	05	S	'
6	0 0110	06	I	8
7	0 0111	07	U	7
8	0 0100	08	CR	CR
9	0 1001	09	D	$
10	0 1010	0A	R	4
11	0 1011	0B	J	BL
12	0 1100	0C	N	,
13	0 1101	0D	F	!
14	0 1110	0E	C	:
15	0 1111	0F	K	(
16	1 0000	10	T	5
17	1 0001	11	Z	"
18	1 0010	12	L	)
19	1 0011	13	W	2
20	1 0100	14	H	#
21	1 0101	15	Y	6
22	1 0110	16	P	0
23	1 0111	17	Q	1
24	1 1000	18	O	9
25	1 1001	19	B	?
26	1 1010	1A	G	&
27	1 1011	1B (figs	SO (shift out)	SO (shift out)
28	1 1100	1C	M	.
29	1 1101	1D	X	/
30	1 1110	1E	V	;
31	1 1111	1F (LTRS	SI (shift in)	SI (shift in

EBCD Character Conversion Table

Dec Value	Binary	Hex	Unshifted Characters	Shifted Characters
0	00 0000	00	⟨space⟩	⟨space⟩
1	00 0001	01	-	—
2	00 0010	02	@	⟨hex⟩ (¢)
3	00 0011	03	&	+
4	00 0100	04	8	*
5	00 0101	05	q	Q
6	00 0110	06	y	Y
7	00 0111	07	h	H
8	00 1000	08	4	:
9	00 1001	09	m	M
10	00 1010	0A	u	U
11	00 1011	0B	d	D
12	00 1100	0C	⟨hex⟩ ⟨PN⟩	⟨hex⟩ ⟨PN⟩
13	00 1101	0D	⟨hex⟩ ⟨RES⟩	⟨hex⟩ ⟨RES⟩
14	00 1110	0E	⟨hex⟩ ⟨BYP⟩	⟨hex⟩ ⟨BYP⟩
15	00 1111	0F	⟨hex⟩ ⟨PF⟩	⟨hex⟩ ⟨PF⟩
16	01 0000	10	2	<
17	01 0001	11	k	K
18	01 0010	12	s	S
19	01 0011	13	b	B
20	01 0100	14	O	)
21	01 0101	15	VT	VT
22	01 0110	16	FF	FF
23	01 0111	17	⟨hex⟩	⟨hex⟩
24	01 1000	18	6	,
25	01 1001	19	o	O
26	01 1010	1A	w	W
27	01 1011	1B	f	F
28	01 1100	1C ⟨UC⟩	SO ⟨shift out⟩	SO ⟨shift out
29	01 1101	1D	BS	BS
30	01 1110	1E	EB	EB
31	01 1111	1F ⟨LC⟩	SI ⟨shift in⟩	SI ⟨shift in⟩
32	10 0000	20	1	=
33	10 0001	21	j	J
34	10 0010	22	/	?
35	10 0011	23	a	A
36	10 0100	24	9	
37	10 0101	25	r	R
38	10 0110	26	z	Z
39	10 0111	27	i	I
40	10 1000	28	5	%
41	10 1001	29	n	N
42	10 1010	2A	v	V
43	10 1011	2B	e	E

EBCD Character Conversion Table (Cont'd)

Dec Value	Binary	Hex	Unshifted Characters	Shifted Characters
44	10 1100	2C	RS	RS
45	10 1101	2D	CR	CR
46	10 1110	2E	LF	LF
47	10 1111	2F	HT	HT
48	11 0000	30	3	;
49	11 0001	31	I	L
50	11 0010	32	t	T
51	11 0011	33	c	C
52	11 0100	34	#	"
53	11 0101	35	$	!
54	11 0110	36	.	.
55	11 0111	37	•	•
56	11 1000	38	7	>
57	11 1001	39	p	P
58	11 1010	3A	x	X
59	11 1011	3B	g	G
60	11 1100	3C	ET	ET
61	11 1101	3D	‹hex› ‹IL›	‹hex› IL›
62	11 1110	3E	ESC	ESC
63	11 1111	3F	‹DEL›	‹DEL›

Transcode Character Conversion Table

Dec Value	Binary	Hex	Displayed Characters	Keyboard Mnemonic
0	00 0000	00	SH	SOH
1	00 0001	01	A	
2	00 0010	02	B	
3	00 0011	03	C	
4	00 0100	04	D	
5	00 0101	05	E	
6	00 0110	06	F	
7	00 0111	07	G	
8	00 1000	08	H	
9	00 1001	09	I	
10	00 1010	0A	SX	STX
11	00 1011	0B	•	
12	00 1100	0C	<	
13	00 1101	0D	BL	BEL
14	00 1110	0E	SB	SUB
15	00 1111	0F	EB	ETB
16	01 0000	10	&	
17	01 0001	11	J	
18	01 0010	12	K	
19	01 0011	13	L	
20	01 0100	14	M	
21	01 0101	15	N	
22	01 0110	16	O	
23	01 0111	17	P	
24	01 1000	18	Q	
25	01 1001	19	R	
26	01 1010	1A	‹space›	
27	01 1011	1B	$	
28	01 1100	1C	*	
29	01 1101	1D	US	US
30	01 1110	1E	ET	EOT
31	01 1111	1F	DL	DLE
32	10 0000	20	-	
33	10 0001	21	/	
34	10 0010	22	S	
35	10 0011	23	T	
36	10 0100	24	U	
37	10 0101	25	V	
38	10 0110	26	W	
39	10 0111	27	X	
40	10 1000	28	Y	
41	10 1001	29	Z	
42	10 1010	2A	EC	ESC
43	10 1011	2B	,	

Transcode Character Conversion Table (Cont'd)

Dec Value	Binary	Hex	Displayed Characters	Keyboard Mnemonic
44	10 1100	2C	%	
45	10 1101	2D	EQ	ENQ
46	10 1110	2E	EX	ETX
47	10 1111	2F	HT	HT
48	11 0000	30	0	
49	11 0001	31	1	
50	11 0010	32	2	
51	11 0011	33	3	
52	11 0100	34	4	
53	11 0101	35	5	
54	11 0110	36	6	
55	11 0111	37	7	
56	11 1000	38	8	
57	11 1001	39	9	
58	11 1010	3A	SY	SYN
59	11 1011	3B	#	
60	11 1100	3C	@	
61	11 1101	3D	NK	NAK
62	11 1110	3E	EM	EM
63	11 1111	3F	▨	DEL

IPARS Character Conversion Table

Dec Value	Binary	Hex	Displayed Character	Keyboard Function
0	00 0000	00	hex	
1	00 0001	01	1	
2	00 0010	02	2	
3	00 0011	03	3	
4	00 0100	04	4	
5	00 0101	05	5	
6	00 0110	06	6	
7	00 0111	07	7	
8	00 1000	08	8	
9	00 1001	09	9	
10	00 1010	0A	0	
11	00 1011	0B	•	
12	00 1100	0C	CR	Return
13	00 1101	0D	EI	End of Medium, Incomplete
14	00 1110	0E	=	Sense

Dec Value	Binary	Hex	Displayed Character	Keyboard Function
15	00 1111	0F	(hex)	Go-Ahead
16	01 0000	10	(hex)	Write
17	01 0001	11	/	Erase/Write
18	01 0010	12	S	
19	01 0011	13	T	
20	01 0100	14	U	
21	01 0101	15	V	
22	01 0110	16	W	
23	01 0111	17	X	
24	01 1000	18	Y	
25	01 1001	19	Z	
26	01 1010	1A	-	
27	01 1011	1B	#	
28	01 1100	1C	(space)	
29	01 1101	1D	EC	End of Medium, Complete
30	01 1110	1E	[	Start
31	01 1111	1F	,	
32	10 0000	20	@	
33	10 0001	21	J	
34	10 0010	22	K	
35	10 0011	23	L	
36	10 0100	24	M	
37	10 0101	25	N	
38	10 0110	26	O	
39	10 0111	27	P	
40	10 1000	28	Q	
41	10 1001	29	R	
42	10 1010	2A	:	UMSG
43	10 1011	2B	<	
44	10 1100	2C	+	
45	10 1101	2D	EU	End of Medium, Unsolicited
46	10 1110	2E	'	
47	10 1111	2F	'	
48	11 0000	30	$	
49	11 0001	31	A	
50	11 0010	32	B	
51	11 0011	33	C	
52	11 0100	34	D	
53	11 0101	35	E	
54	11 0110	36	F	
55	11 0111	37	G	
56	11 1000	38	H	
57	11 1001	39	I	
58	11 1010	3A	?	
59	11 1011	3B	.	
60	11 1100	3C	%	
61	11 1101	3D	EP	End of Medium, Push Button
62	11 1110	3E	S2	Sync 2
63	11 1111	3F	S1	Sync 1, Reset

Note: The SYN keycap maps to the Sync 2, hex 3E character

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UNITED KINGDOM

Hewlett-Packard Ltd.
Nine Mile Ride
Easthampstead, **WOKINGHAM**
Berkshire, IRGll 3LL
Tel: 0344 773100
Telex: 848805

EASTERN USA

Hewlett-Packard Co.
4 Choke Cherry Road
ROCKVILLE, MD 20850
Tel: (301) 948-6370

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Hewlett-Packard Co.
5201 Tollview Drive
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Tel: (312) 255-9800

SOUTHERN USA

Hewlett-Packard Co.
2000 South Park Place
ATLANTA, GA 30339
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Tel: (818) 505-5600

OTHER INTERNATIONAL AREAS

Hewlett-Packard Co.
Intercontinental Headquarters
3495 Deer Creek Road
PALO ALTO, CA 94304
Tel: (415) 857-1501
Telex: 034-8300
Cable: HEWPACK

ALGERIA

Bureau de Liaison
Hewlett-Packard Alger
Villa des Lions
9, Hai Galloul
DZ-BORDJ EL BAHRI
Tel: 76 03 36
Telex: 51260 dliondz

ANGOLA

Telectra Angola LDA
Empresa Técnica de Equipamentos
Rua Barbosa Rodrigues, 41-1 DT.
Caixa Postal 6487
LUANDA
Tel: 35515,35516
Telex: 3134
E,P

ARGENTINA

Hewlett-Packard Argentina S.A.
Montaneses 2140/50
1428 **BUENOS AIRES**
Tel: 781-4059/69
Cable: HEWPACKARG
A,C,E,P
Biotron S.A.C.I.M.e.I.
Av. Paso Colon 221, Piso 9
1399 **BUENOS AIRES**
Tel: 541-333-490,
541-322-587
Telex: 17595 BIONAR
M
Laboratorio Rodriguez
Corswant S.R.L.
Misiones, 1156 - 1876
Bernal, Oeste
BUENOS AIRES
Tel: 252-3958, 252-4991
A
Argentina Esanco S.R.L.
A/ASCO 2328
1416 **BUENOS AIRES**
Tel: 541-58-1981, 541-59-2767
Telex: c/o 9400 HPARGENTINA
A

AUSTRALIA

Adelaide, South Australia Office

Hewlett-Packard Australia Ltd.
153 Greenhill Road
PARKSIDE, S.A. 5063
Tel: 272-5911
Telex: 82536
Cable: HEWPARD Adelaide
A*,C,CM,E,P

Brisbane, Queensland Office

Hewlett-Packard Australia Ltd.
10 Payne Road
THE GAP, Queensland 4061
Tel: 30-4133
Telex: 42133
Cable: HEWPARD Brisbane
A,C,CM,E,M,P

Canberra, Australia Capital Territory Office

Hewlett-Packard Australia Ltd.
Thynne Street, Fern Hill Park
BRUCE, A.C.T. 2617
P.O. Box 257,
JAMISON, A.C.T. 2614
Tel: 51 6999
Telex: 62650
Cable: HEWPARD Canberra
C,CM,E,P

Melbourne, Victoria Office

Hewlett-Packard Australia Ltd.
31-41 Joseph Street
P.O. Box 221
BLACKBURN, Victoria 3130
Tel: 895-2895
Telex: 31-024
Cable: HEWPARD Melbourne
A,C,CM,E,M,P

Perth, Western Australia Office

Hewlett-Packard Australia Ltd.
261 Stirling Highway
CLAREMONT, W.A. 6010
Tel: 383-2188
Telex: 93859
Cable: HEWPARD Perth
C,CM,E,P

Sydney, New South Wales Office

Hewlett-Packard Australia Ltd.
17-23 Talavera Road
P.O. Box 308
NORTH RYDE, N.S.W. 2113
Tel: 888-4444
Telex: 21561
Cable: HEWPARD Sydney
A,C,CM,E,M,P

AUSTRIA

Hewlett-Packard Ges.m.b.h.
Verkaufsbuero Graz
Grottenhofstrasse 94
A-8052 **GRAZ**
Tel: (0316) 28-30-66
Telex: 312375
C,E

Hewlett-Packard Ges.m.b.h
Lieblgasse 1
P.O Box 72
A-1222 **VIENNA**
Tel: (0222) 2500-0
Telex: 134425 HEPA A
A,C,CM,E,M,P

BAHRAIN

Green Salon
P.O. Box 557
MANAMA
Tel: 255503-250950
Telex: 84419
P

Wael Pharmacy
P.O. Box 648
MANAMA
Tel: 256123
Telex: 8550 WAEL BN
E,M

SALES & SUPPORT OFFICES
Arranged alphabetically by country

BAHRAIN (Cont'd)
Zayani Computer Systems
218 Shaik Mubarak Building
Government Avenue
P.O. Box 5918
MANAMA
Tel: 276278
Telex: 9015 plans bn
P

BELGIUM
Hewlett-Packard Belgium S.A./N.V.
Blvd de la Woluwe, 100
Woluwedal
B-1200 **BRUSSELS**
Tel: (02) 762-32-00
Telex: 23-494 paloben bru
A,C,CM,E,M,P

BERMUDA
Applied Computer Technologies
Atlantic House Building
Par-La-Ville Road
HAMILTON 5
Tel: 295-1816
Telex: 380 3589/ACT BA
P

BOLIVIA
Arrellano Ltda
Av. 20 de Octubre #2125
Casilla 1383
LA PAZ
Tel: 368541
M

BRAZIL
Hewlett-Packard do Brasil
I.e.C. Ltda.
Alameda Rio Negro, 750
ALPHAVILLE
06400 Barueri SP
Tel: (011) 421.1311
Telex: (011) 33872 HPBR-BR
Cable: HEWPACK Sao Paulo
A,C,CM,E,M,P
Hewlett-Packard do Brasil
I.e.C. Ltda.
Praia de Botafago 228
6° Andar-conj 614
Edificio Argentina - Ala A
22250 **RIO DE JANEIRO,** RJ
Tel: (02I) 552-6422
Telex: 21905 HPBR-BR
Cable: HEWPACK Rio de Janeiro
A,C,CM,E,P*
Convex/Van Den
Rua Jose Bonifacio
458 Todos Os Santos
CEP 20771
RIO DE JANEIRO, RJ
Tel: 591-0197
Telex: 33487 EGLB BR
A
ANAMED I.C.E.I. Ltda.
Rua Bage, 103
04012 **SAO PAULO,** SP
Tel: (011) 572-6537
Telex: 24720 HPBR-BR
M
Datatronix Electronica Ltda.
Av. Pacaembu 746-C11
SAO PAULO, SP
Tel: (118) 260111
CM

BRUNEI
Komputer Wisman Sdn Bhd
Room 1
3rd Floor, Tumasek Plaza
Jalan Tutong
BANDAR SERI BEGAWAN
Tel: 23918,25603
C,E,P

CAMEROON
Beriac
B. P. 23
DOUALA
Tel: 420153
Telex: 5351
C,P

CANADA

Alberta
Hewlett-Packard (Canada) Ltd.
3030 3rd Avenue N.E.
CALGARY, Alberta T2A 6T7
Tel: (403) 235-3100
A,C,CM,E*,M,P*
Hewlett-Packard (Canada) Ltd.
11120-178th Street
EDMONTON, Alberta T5S 1P2
Tel: (403) 486-6666
A,C,CM,E,M,P

British Columbia
Hewlett-Packard (Canada) Ltd.
10691 Shellbridge Way
RICHMOND,
British Columbia V6X 2W8
Tel: (604) 270-2277
Telex: 610-922-5059
A,C,CM,E*,M,P*
Hewlett-Packard (Canada) Ltd.
121 - 3350 Douglas Street
VICTORIA, British Columbia V8Z 3L1
Tel: (604) 381-6616
C

Manitoba
Hewlett-Packard (Canada) Ltd.
1825 Inkster Blvd.
WINNIPEG, Manitoba R2X 1R3
Tel: (204) 694-2777
A,C,CM,E,M,P*

New Brunswick
Hewlett-Packard (Canada) Ltd.
814 Main Street
MONCTON, New Brunswick E1C 1E6
Tel: (506) 855-2841
C

Nova Scotia
Hewlett-Packard (Canada) Ltd.
Suite 111
900 Windmill Road
DARTMOUTH, Nova Scotia B3B 1P7
Tel: (902) 469-7820
C,CM,E*,M,P*

Ontario
Hewlett-Packard (Canada) Ltd.
3325 N. Service Rd., Unit W03
BURLINGTON, Ontario L7N 3G2
Tel: (416) 335-8644
C,M*
Hewlett-Packard (Canada) Ltd.
496 Days Road
KINGSTON, Ontario K7M 5R4
Tel: (613) 384-2088
C
Hewlett-Packard (Canada) Ltd.
552 Newbold Street
LONDON, Ontario N6E 2S5
Tel: (519) 686-9181
A,C,CM,E*,M,P*
Hewlett-Packard (Canada) Ltd.
6877 Goreway Drive
MISSISSAUGA, Ontario L4V 1M8
Tel: (416) 678-9430
Telex: 069-8644
A,C,CM,E,M,P
Hewlett-Packard (Canada) Ltd.
2670 Queensview Dr.
OTTAWA, Ontario K2B 8K1
Tel: (613) 820-6483
A,C,CM,E*,M,P*
Hewlett-Packard (Canada) Ltd.
The Oaks Plaza, Unit #9
2140 Regent Street
SUDBURY, Ontario, P3E 5S8
Tel: (705) 522-0202
C
Hewlett-Packard (Canada) Ltd.
3790 Victoria Park Ave.
WILLOWDALE, Ontario M2H 3H7
Tel: (416) 499-2550
C,E

Quebec
Hewlett-Packard (Canada) Ltd.
17500 Trans Canada Highway
South Service Road
KIRKLAND, Quebec H9J 2X8
Tel: (514) 697-4232
Telex: 058-21521
A,C,CM,E,M,P*
Hewlett-Packard (Canada) Ltd.
1150 rue Claire Fontaine
QUEBEC CITY, Quebec G1R 5G4
Tel: (418) 648-0726
C
Hewlett-Packard (Canada) Ltd.
130 Robin Crescent
SASKATOON, Saskatchewan S7L 6M7
Tel: (306) 242-3702
C

CHILE
ASC Ltda.
Austria 2041
SANTIAGO
Tel: 223-5946, 223-6148
Telex: 340192 ASC CK
C,P
Jorge Calcagni y Cia
Av. Italia 634 Santiago
Casilla 16475
SANTIAGO 9
Tel: 222-0222
Telex: 440283 JCYCL CZ
CM,E,M
Metrolab S.A.
Monjitas 454 of. 206
SANTIAGO
Tel: 395752, 398296
Telex: 340866 METLAB CK
A
Olympia (Chile) Ltda.
Av. Rodrigo de Araya 1045
Casilla 256-V
SANTIAGO 21
Tel: 225-5044
Telex: 340892 OLYMP
Cable: Olympiachile Santiagochile
C,P

CHINA, People's Republic of
China Hewlett-Packard Co., Ltd.
47/F China Resources Bldg.
26 Harbour Road
HONG KONG
Tel: 5-8330833
Telex: 76793 HPA HX
Cable: HP ASIA LTD
A*,M*
China Hewlett-Packard Co., Ltd.
P.O. Box 9610, Beijing
4th Floor, 2nd Watch Factory Main Bldg.
Shuang Yu Shou, Bei San Huan Road
Hai Dian District
BEIJING
Tel: 28-0567
Telex: 22601 CTSHP CN
Cable: 1920 Beijing
A,C,CM,E,M,P
China Hewlett-Packard Co., Ltd.
CHP Shanghai Branch
23/F Shanghai Union Building
100 Yan An dong Lu
SHANG-HAI
Tel: 265550
Telex: 33571 CHPSB CN
Cable: 3416 Shanghai
A,C,CM,E,M,P

COLOMBIA
Instrumentación
H. A. Langebaek & Kier S.A.
Carrerra 4A No. 52A-26
Apartado Aereo 6287
BOGOTA 1, D.E.
Tel: 212-1466
Telex: 44400 INST CO
Cable: AARIS Bogota
CM,E,M
Nefromedicas Ltda.
Calle 123 No. 9B-31
Apartado Aereo 100-958
BOGOTA D.E., 10
Tel: 213-5267, 213-1615
Telex: 43415 HEGAS CO
A
Compumundo
Avenida 15 # 107-80
BOGOTA D.E.
Tel: 214-4458
Telex: 45466 SUMA CO
P
Carvajal, S.A.
Calle 29 Norte No. 6A-40
Apartado Aereo 46
CALI
Tel: 368-1111
Telex: 55650
C,E,P

CONGO
Seric-Congo
B. P. 2105
BRAZZAVILLE
Tel: 815034
Telex: 5262

COSTA RICA
Cientifica Costarricense S.A.
Avenida 2, Calle 5
San Pedro de Montes de Oca
Apartado 10159
SAN JOSÉ
Tel: 24-38-20, 24-08-19
Telex: 2367 GALGUR CR
CM,E,M

O. Fischel R. Y. Cia. S.A.
Apartados 434-10174
SAN JOSE
Tel: 23-72-44
Telex: 2379
Cable: OFIR
A

CYPRUS
Telerexa Ltd.
P.O. Box 1152
7 A Afroditis Avenue
NICOSIA
Tel: 45 628, 62 698
Telex: 2894 LEVIDO CY
E,M,P

DENMARK
Hewlett-Packard A/S
Kongevejen 25
DK-3460 **BIRKEROED**
Tel: (02) 81-66-40
Telex: 37409 hpas dk
A,C,CM,E,M,P

Hewlett-Packard A/S
Rolighedsvej 32
DK-8240 **RISSKOV,** Aarhus
Tel: (06) 17-60-00
Telex: 37409 hpas dk
C,E

DOMINICAN REPUBLIC
Microprog S.A.
Juan Tomás Mejía y Cotes No. 60
Arroyo Hondo
SANTO DOMINGO
Tel: 565-6268
Telex: 4510 ARENTA DR (RCA)
P

ECUADOR
CYEDE Cia. Ltda.
Avenida Eloy Alfaro 1749
y Belgica
Casilla 6423 CCI
QUITO
Tel: 245-0975, 243-052
Telex: 22548 CYEDE ED
E,P

Medtronics
Valladolid 524 Madrid
P.O 9171, **QUITO**
Tel: 2-238-951
Telex 2298 ECUAME ED
A

Hospitalar S.A.
Robles 625
Casilla 3590
QUITO
Tel: 545-250, 545-122
Telex: 2485 HOSPTL ED
Cable: HOSPITALAR-Quito
M

Ecuador Overseas Agencies C.A.
Calle 9 de Octubre #818
P.O. Box 1296, Guayaquil
QUITO
Tel: 306022
Telex: 3361 PBCGYE ED
M

EGYPT
Sakrco Enterprises
P.O. Box 259
ALEXANDRIA
Tel: 802908, 808020, 805302
Telex: 54333
C

International Engineering Associates
24 Hussein Hegazi Street
Kasr-el-Aini
CAIRO
Tel: 23829, 21641
Telex: 93830 IEA UN
Cable: INTEGASSO
E

Sakrco Enterprises
70 Mossadak Street
Dokki, Giza
CAIRO
Tel: 706 440, 701 087
Telex: 9337
C

S.S.C. Medical
40 Gezerat El Arab Street
Mohandessin
CAIRO
Tel: 803844, 805998, 810263
Telex: 20503 SSC UN
M*

EL SALVADOR
IPESA de El Salvador S.A.
29 Avenida Norte 1223
SAN SALVADOR
Tel: 26-6858, 26-6868
Telex: 301 20539 IPESA SAL
A,C,CM,E,P

ETHIOPIA
Seric-Ethiopia
P.O. Box 2764
ADDIS ABABA
Tel: 185114
Telex: 21150
C,P

FINLAND
Hewlett-Packard Oy
Piispankallionte 17
02200 **ESPOO**
Tel: 00358-0-88721
Telex: 121563 HEWPA SF
C,CM,P

FRANCE
Hewlett-Packard France
Z.I. Mercure B
Rue Berthelot
13763 Les Milles Cedex
AIX-EN-PROVENCE
Tel: (42) 59-41-02
Telex: 410770F
A,C,E,M

Hewlett-Packard France
64, Rue Marchand Saillant
61000 **ALENCON**
Tel: (33) 29 04 42
C**

Hewlett-Packard France
Batiment Levitan
2585, route de Grasse
Bretelle Autoroute
06600 **ANTIBES**
Tel: (93) 74-59-19
C

Hewlett-Packard France
28 Rue de la République
Boite Postale 503
25026 **BESANÇON**
Tel: (81) 83-16-22
Telex: 361157
C,E*

Hewlett-Packard France
13 Place Napoléan III
29000 **BREST**
Tel: (98) 41-87-90
E

Hewlett-Packard France
Chemin des Mouilles
Boite Postale 162
69131 **ECULLY** Cedex (Lyon)
Tel: (78) 133-81-25
Telex: 310617F
A,C,E,M,P*

Hewlett-Packard France
Parc d'activités du Bois Briard
Avenue du Lac
91040 **EVRY** Cedex
Tel: (60) 77-83-83
Telex: 692315F
C

Hewlett-Packard France
5, avenue Raymond Chanas
38320 **EYBENS** (Grenoble)
Tel: (76) 62-57-98
Telex: 980124 HP GRENOB EYBE
C

Hewlett-Packard France
Rue Fernand. Forest
Z.A. Kergaradec
29239 **GOUESNOU**
Tel: (98) 41-87-90

Hewlett-Packard France
Parc Club des Tanneries
Batiment B4
4, Rue de la Faisanderie
67380 **LINCOLSHEIM**
(Strasbourg)
Tel: (88) 76-15-00
Telex 890141F
C,E*,M*,P*

Hewlett-Packard France
Centre d'affaires Paris-Nord
Bâtiment Ampère
Rue de la Commune de Paris
Boite Postale 300
93153 **LE BLANC-MESNIL**
Tel: (1) 865-44-52
Telex: 211032F
C,E,M

Hewlett-Packard France
Parc d'activités Cadéra
Quartier Jean-Mermoz
Avenue du Président JF Kennedy
33700 **MÉRIGNAC** (Bordeaux)
Tel: (56) 34-00-84
Telex: 550105F
C,E,M

Hewlett-Packard France
3, Rue Graham Bell
BP 5149
57074 **METZ** Cedex
Tel: (87) 36-13-31
Telex: 860602F
C,E

Hewlett-Packard France
Miniparc-ZIRST
Chemin du Vieux Chêne
38240 **MEYLAN** (Grenoble)
Tel: (76) 90-38-40
C

Hewlett-Packard France
Bat.A l'Erable
Bureau vert du Bois Briand
44085 **NANTES** Cedex
Tel: (40) 50-32-22
Telex: 711085F
A,C,E,CM*,P

Hewlett-Packard France
125, Rue du Faubourg Bannier
45000 **ORLÉANS**
Tel: (38) 62-20-31
E,P*

Hewlett-Packard France
Zone Industrielle de Courtaboeuf
Avenue des Tropiques
91947 **LES ULIS** Cedex (Orsay)
Tel: (69) 07-78-25
Telex: 600048F
A,C,CM,E,M,P**

Hewlett-Packard France
15, Avenue de L'Amiral-Bruix
75782 **PARIS** Cedex 16
Tel: (1) 45-02-75-00
Telex: 613663F
C,P*

Hewlett-Packard France
124, Boulevard Tourasse
64000 **PAU**
Tel: (59) 80-38-02
Telex: 550365F
C,E*

Hewlett-Packard France
6, Place Sainte Croix
86000 **POITIERS**
Tel: (49) 41-27-07
Telex: 792335F
C, E*

SALES & SUPPORT OFFICES
Arranged alphabetically by country

FRANCE (Cont'd)
Hewlett-Packard France
47, Rue de Chativesle
51100 **REIMS**
Tel: (26) 88-69-79
C, P*

Hewlett-Packard France
Parc d'activités de la Poterie
Rue Louis Kerautel-Botmel
35000 **RENNES**
Tel: (99) 51-42-44
Telex: 740912F
A*,C,E,M,P*

Hewlett-Packard France
98 Avenue de Bretagne
76100 **ROUEN**
Tel: (35) 63-57-66
Telex: 770035F
C,E

Hewlett-Packard France
4, Rue Thomas-Mann
Boite Postale 56
67033 **STRASBOURG** Cedex
Tel: (88) 28-56-46
Telex: 890141F
C,E,M,P*

Hewlett-Packard France
Le Péripole
3, Chemin du Pigeonnier de la Cépière
3108 **TOULOUSE** Cedex
Tel: (61) 40-11-12
Telex: 531639F
A,C,E,M,P*

Hewlett-Packard France
Les Cardoulines
Batiment B2
Route des Dolines
Parc d'activite de Valbonne
Sophia Antipolis
06560 **VALBONNE** (Nice)
Tel: (93) 65-39-40
C

Hewlett-Packard France
9, Rue Baudin
26000 **VALENCE**
Tel: (75) 42-76-16
C**

Hewlett-Packard France
Carolor
ZAC de Bois Briand
57640 **VIGY** (Metz)
Tel: (8) 771 20 22
C

Hewlett-Packard France
Parc d'activité des Prés
1, Rue Papin
59658 **VILLENEUVE D'ASCQ** Cedex
Tel: (20) 47 78 78
Telex: 160124F
C,E,M,P

Hewlett-Packard France
Parc d'activités Paris-Nord 11
45, Rue des 3 Soeurs
93420 **VILLEPINTE**
Tel: (1) 48 63 80 80
Telex: 211032F
C,E,M,P*

GABON
Sho Gabon
P.O. Box 89
LIBREVILLE
Tel: 721 484
Telex: 5230

GERMAN FEDERAL REPUBLIC
Hewlett-Packard GmbH
Vertriebszentrum Mitte
Hewlett-Packard-Strasse
D-6380 **BAD HOMBURG**
Tel: (06172) 400-0
Telex: 410 844 hpbhg
A,C,E,M,P

Hewlett-Packard GmbH
Geschäftsstelle
Keithstrasse 2-4
D-1000 **BERLIN** 30
Tel: (030) 21 99 04-0
Telex: 018 3405 hpbln d
A,C,E,M,P

Hewlett-Packard GmbH
Vertriebszentrun Südwest
Schickardstrasse 2
D-7030 **BÖBLINGEN**
Tel: (07031) 645-0
Telex: 7265 743 hep
A,C,CM,E,M,P

Hewlett-Packard GmbH
Geschäftsstelle
Schleefstr. 28a
D-4600 **DORTMUND**-41
Tel: (0231) 45001
Telex: 822858 hepdad
A,C,E

Hewlett-Packard GmbH
Vertriebszentrum Nord
Kapstadtring 5
D-2000 **HAMBURG** 60
Tel: (040) 63804-1
Telex: 021 63 032 hphh d
A,C,E,M,P

Hewlett-Packard GmbH
Geschäftsstelle
Heidering 37-39
D-3000 **HANNOVER** 61
Tel: (0511) 5706-0
Telex: 092 3259
A,C,CM,E,M,P

Hewlett-Packard GmbH
Geschäftsstelle
Rosslauer Weg 2-4
D-6800 **MANNHEIM**
Tel: (0621) 70 05-0
Telex: 0462105
A,C,E

Hewlett-Packard GmbH
Geschäftsstelle
Messerschmittstrasse 7
D-7910 **NEU ULM**
Tel: (0731) 70 73-0
Telex: 0712816 HP ULM-D
A,C,E*

Hewlett-Packard GmbH
Geschäftsstelle
Emmericher Strasse 13
D-8500 **NÜRNBERG** 10
Tel: (0911) 5205-0
Telex: 0623 860 hpnbg
C,CM,E,M,P

Hewlett-Packard GmbH
Vertriebszentrum West
Berliner Strasse 111
D-4030 **RATINGEN** 3
Tel: (02102) 494-0
Telex: 589 070 hprad
A,C,E,M,P

Hewlett-Packard GmbH
Vertriebszentrum Süd
Eschenstrasse 5
D-8028 **TAUFKIRCHEN**
Tel: (089) 61 20 7-0
Telex: 0524985
A,C,CM,E,M,P

Hewlett-Packard GmbH
Geschäftsstelle
Ermlisallee
7517 **WALDBRONN** 2
Tel: (07243) 602-0
Telex: 782 838 hepk
A,C,E

GREAT BRITAIN
See United Kingdom

GREECE
Hewlett-Packard A.E.
178, Kifissias Avenue
6th Floor
Halandri-**ATHENS**
Greece
Tel: 6471543, 6471673, 6472971
Telex: 221 286 HPHLGR
A,C,CM**,E,M,P

Kostas Karaynnis S.A.
8, Omirou Street
ATHENS 133
Tel: 32 30 303, 32 37 371
Telex: 215962 RKAR GR
A,C*,CM,E

Impexin
Intelect Div.
209 Mesogion
11525 **ATHENS**
Tel: 6474481/2
Telex: 216286
P

Harll Company
38, Mihalakopoulou
ATHENS 612
Tel: 7236071
Telex: 218767
M*

Hellamco
P.O. Box 87528
18507 **PIRAEUS**
Tel: 4827049
Telex: 241441
A

GUATEMALA
IPESA
Avenida Reforma 3-48, Zona 9
GUATEMALA CITY
Tel: 316627, 317853,66471/5
Telex: 3055765 IPESA GU
A,C,CM,E,M,P

HONG KONG
Hewlett-Packard Hong Kong, Ltd.
G.P.O. Box 795
5th Floor, Sun Hung Kai Centre
30 Harbour Road
HONG KONG
Tel: 5-8323211
Telex: 66678 HEWPA HX
Cable: HEWPACK HONG KONG
E,C,P

CET Ltd.
10th Floor, Hua Asia Bldg.
64-66 Gloucester Road
HONG KONG
Tel: (5) 200922
Telex: 85148 CET HX
CM

Schmidt & Co. (Hong Kong) Ltd.
18th Floor, Great Eagle Centre
23 Harbour Road, Wanchai
HONG KONG
Tel: 5-8330222
Telex: 74766 SCHMC HX
A,M

ICELAND
Hewlett-Packard Iceland
Hoefdabakka 9
110 **REYKJAVIK**
Tel: (1) 67 1000
A,C,CM,E,M,P

INDIA
Computer products are sold through Blue Star Ltd.All computer repairs and maintenance service is done through Computer Maintenance Corp.

Blue Star Ltd.
B. D. Patel House
Near Sardar Patel Colony
AHMEDABAD 380 014
Tel: 403531, 403532
Telex: 0121-234
Cable: BLUE FROST
A,C,CM,E

Blue Star Ltd.
40/4 Lavelle Road
BANGALORE 560 001
Tel: 57881, 567780
Telex: 0845-430
Cable: BLUESTAR
A,C*,CM,E

Blue Star Ltd.
Band Box House
Prabhadevi
BOMBAY 400 025
Tel: 4933101, 4933222
Telex: 011-71051
Cable: BLUESTAR
A,M

Blue Star Ltd.
Sahas
414/2 Vir Savarkar Marg
Prabhadevi
BOMBAY 400 025
Tel: 430-6155, 430-6556
Telex: 011-71193 BSSS IN
Cable: FROSTBLUE
A,CM,E,M

Blue Star Ltd.
Kalyan, 19 Vishwas Colony
Alkapuri, **BORODA,** 390 005
Tel: 65235, 65236
Cable: BLUE STAR
A

Blue Star Ltd.
7 Hare Street
CALCUTTA 700 001
Tel: 230131, 230132
Telex: 031-61120 BSNF IN
Cable: BLUESTAR
A,M,C,E

Blue Star Ltd.
133 Kodambakkam High Road
MADRAS 600 034
Tel: 472056, 470238
Telex: 041-379
Cable: BLUESTAR
A,M

Blue Star Ltd.
13 Community Center
New Friends Colony
NEW DELHI 110 065
Tel: 633182, 636674
Telex: 031-61120
Cable: BLUEFROST
A,C*,CM,E,M

Blue Star Ltd.
15/16 C Wellesley Rd.
PUNE 411 011
Tel: 22775
Cable: BLUE STAR
A

Blue Star Ltd.
2-2-47/1108 Bolarum Rd.
SECUNDERABAD 500 003
Tel: 72057, 72058
Telex: 0155-459
Cable: BLUEFROST
A,C,E

Blue Star Ltd.
T.C. 7/603 Poornima
Maruthunkuzhi
TRIVANDRUM 695 013
Tel: 65799, 65820
Telex: 0884-259
Cable: BLUESTAR
E

Computer Maintenance Corporation Ltd.
115, Sarojini Devi Road
SECUNDERABAD 500 003
Tel: 310-184, 345-774
Telex: 031-2960
C**

INDONESIA

BERCA Indonesia P.T.
P.O.Box 496/Jkt.
Jl. Abdul Muis 62
JAKARTA
Tel: 21-373009
Telex: 46748 BERSAL IA
Cable: BERSAL JAKARTA
F

BERCA Indonesia P.T.
P.O.Box 2497/Jkt
Antara Bldg., 11th Floor
Jl. Medan Merdeka Selatan 17
JAKARTA-PUSAT
Tel: 343989
Telex: 46748 BERSAL IA
A,C,E,M,P

BERCA Indonesia P.T.
Jalan Kutai 24
SURABAYA
Tel: 67118
Telex: 31146 BERSAL SB
Cable: BERSAL-SURABAYA
A*,E,M,P

IRAQ

Hewlett-Packard Trading S.A.
Service Operation
Al Mansoor City 9B/3/7
BAGHDAD
Tel: 551-49-73
Telex: 212-455 HEPAIRAQ IK
C

IRELAND

Hewlett-Packard Ireland Ltd.
82/83 Lower Leeson Street
DUBLIN 2
Tel: 0001 608800
Telex: 30439
C,E,P

Cardiac Services Ltd.
128 Dublin Industrial Estate
DUBLIN 11
Tel: (01) 307499
Telex: 32254
M

ISRAEL

Eldan Electronic Instrument Ltd.
P.O.Box 1270
JERUSALEM 91000
16, Ohaliav St.
JERUSALEM 94467
Tel: 533 221, 553 242
Telex: 25231 AB/PAKRD IL
A,M

Computation and Measurement Systems (CMS) Ltd.
11 Masad Street
67060
TEL-AVIV
Tel: 388 388
Telex: 33569 Motil IL
C,CM,E,P

ITALY

Hewlett-Packard Italiana S.p.A
Traversa 99C
Via Giulio Petroni, 19
I-70124 **BARI**
Tel: (080) 41-07-44
C,M

Hewlett-Packard Italiana S.p.A.
Via Emilia, 51/C
I-40011 **BOLOGNA** Anzola Dell'Emilia
Tel: (051) 731061
Telex: 511630
C,E,M

Hewlett-Packard Italiana S.p.A.
Via Principe Nicola 43G/C
I-95126 **CATANIA**
Tel: (095) 37-10-87
Telex: 970291
C

Hewlett-Packard Italiana S.p.A.
Via G. di Vittorio 9
20094 **CORSICO** (Milano)
Tel: (02) 448351

Hewlett-Packard Italiana S.p.A.
Viale Brigata Bisagno 2
16129 **GENOVA**
Tel: (010) 541141

Hewlett-Packard Italiana S.p.A.
Viale G. Modugno 33
I-16156 **GENOVA PEGLI**
Tel: (010) 68-37-07
Telex: 215238
C,E

Hewlett-Packard Italiana S.p.A.
Via G. di Vittorio 9
I-20063 **CERNUSCO SUL NAVIGLIO**
(Milano)
Tel: (02) 923691
Telex: 334632
A,C,CM,E,M,P

Hewlett-Packard Italiana S.p.A.
Via Nuova Rivoltana 95
20090 **LIMITO** (Milano)
Tel: (02) 92761

Hewlett-Packard Italiana S.p.A.
Via Nuova San Rocco a Capodimonte, 62/A
I-80131 **NAPOLI**
Tel: (081) 7413544
Telex: 710698
A**,C,E,M

Hewlett-Packard Italiana S.p.A.
Via Orazio 16
80122 **NAPOLI**
Tel: (081) 7611444

Hewlett-Packard Italiana S.p.A.
Via Pellizzo 15
35128 **PADOVA**
Tel: (049) 8070166
Telex: 430315
A,C,E,M

Hewlett-Packard Italiana S.p.A.
Viale C. Pavese 340
I-00144 **ROMA EUR**
Tel: (06) 54831
Telex: 610514
A,C,E,M,P*

Hewlett-Packard Italiana S.p.A.
Via di Casellina 57/C
I-50018 **SCANDICCI-FIRENZE**
Tel: (055) 753863
C,E,M

Hewlett-Packard Italiana S.p.A.
Corso Svizzera, 185
I-10144 **TORINO**
Tel: (011) 74 4044
Telex: 221079
A*,C,E

IVORY COAST

S.I.T.E.L.
Societe Ivoirienne de Telecommunications
Bd. Giscard d'Estaing
Carrefour Marcory
Zone 4.A.
Boite postale 2580
ABIDJAN 01
Tel: 353600
Telex: 43175
E

S.I.T.I.
Immeuble "Le General"
Av. du General de Gaulle
01 BP 161
ABIDJAN 01
Tel: 321227
C,P

JAPAN

Yokogawa-Hewlett-Packard Ltd.
152-1, Onna
ATSUGI, Kanagawa, 243
Tel: (0462) 25-0031
C,CM,E

Yokogawa-Hewlett-Packard Ltd.
Meiji-Seimei Chiba Bldg.
3-1 Hon Chiba-Cho
CHIBA, 280
Tel: (0472) 25 7701
C,E

Yokogawa-Hewlett-Packard Ltd.
Yasuda-Seimei Hiroshima Bldg.
6-11, Hon-dori, Naka-ku
HIROSHIMA, 730
Tel: (082) 241-0611

Yokogawa-Hewlett-Packard Ltd.
Towa Building
2-3, Kaigan-dori, 2 Chome Chuo-ku
KOBE, 650
Tel: (078) 392-4791
C,E

Yokogawa-Hewlett-Packard Ltd.
Kumagaya Asahi 82 Bldg.
3-4 Tsukuba
KUMAGAYA, Saitama 360
Tel: (0485) 24-6563
C,CM,E

Yokogawa-Hewlett-Packard Ltd.
Asahi Shinbun Daiichi Seimei Bldg.
4-7, Hanabata-cho
KUMAMOTO, 860
Tel: (0963) 54-7311
C,E

Yokogawa-Hewlett-Packard Ltd.
Shin-Kyoto Center Bldg
614, Higashi-Shiokoji-cho
Karasuma-Nishiiru
Shiokoji-dori, Shimogyo-ku
KYOTO, 600
Tel: 075-343-0921
C,E

Yokogawa-Hewlett-Packard Ltd
Mito Mitsui Bldg
4-73, Sanno-maru, 1 Chome
MITO, Ibaraki 310
Tel: (0292) 25-7470
C,CM,E

SALES & SUPPORT OFFICES
Arranged alphabetically by country

JAPAN (Cont'd)

Yokogawa-Hewlett-Packard Ltd.
Meiji-Seimei Kokubun Bldg.
7-8 Kokubun, 1 Chome, Sendai
MIYAGI, 980
Tel: (0222) 25-1011
C,E

Yokogawa-Hewlett-Packard Ltd.
Gohda Bldg. 2F
2-10 Gohda 1 Chome
Okaya-Shi
NAGANO, 394
Tel: (0266) 23 0851
C,E

Yokogawa-Hewlett-Packard Ltd.
Nagoya Kokusai Center Building
47-1, Nagono, 1 Chome
Nakamura-ku
NAGOYA, 450
Tel: (052) 571-5171
C,CM,E,M

Yokogawa-Hewlett-Packard Ltd.
Sai-Kyo-Ren Building
1-2 Dote-cho
OHMIYA OHMIYA, Saitama 330
Tel: (0486) 45-8031

Yokogawa-Hewlett-Packard Ltd.
Chuo Bldg.,
4-20 Nishinakajima, 5 Chome
Yodogawa-ku
OSAKA, 532
Tel: (06) 304-6021
Telex: YHPOSA 523-3624
C,CM,E,M,P*

Yokogawa-Hewlett-Packard Ltd.
27-15, Yabe, 1 Chome
SAGAMIHARA Kanagawa, 229
Tel: 0427 59-1311

Yokogawa-Hewlett-Packard Ltd.
Motoshiro-cho Dai-ich Seimei Bldg. 1F
219-21 Motoshiro-cho,
Hamamatsu-shi
SHIZUOKA, 430
Tel: (0534) 56 1771
C,E

Yokogawa-Hewlett-Packard Ltd.
Daiichi Seimei Bldg.
7-1, Nishi Shinjuku, 2 Chome
Shinjuku-ku,**TOKYO** 160
Tel: 03-348-4611
C,E,M

Yokogawa Hewlett-Packard Ltd.
9-1, Takakura-cho
Hachioji-shi, **TOKYO,** 192
Tel: 0426-42-1261
C,E

Yokogawa-Hewlett-Packard Ltd.
29-21 Takaido-Higashi, 3 Chome
Suginami-ku **TOKYO** 168
Tel: (03) 331-6111
Telex: 232-2024 YHPTOK
C,CM,E,P*

Yokogawa Hokushin Electric Corporation
Shinjuku-NS Bldg. 10F
4-1 Nishi-Shinjuku 2-Chome
Shinjuku-ku
TOKYO, 163
Tel: (03) 349-1859
Telex: J27584
A

Yokogawa Hokushin Electric Corp.
9-32 Nokacho 2 Chome
2 Chome Musashino-shi
TOKYO, 180
Tel: (0422) 54-1111
Telex: 02822-421 YEW MTK J
A

Yokogawa-Hewlett-Packard Ltd.
Meiji-Seimei
Utsunomiya Oodori Building
1-5 Oodori, 2 Chome
UTSUNOMIYA, Tochigi 320
Tel: (0286) 33-1153
C,E

Yokogawa-Hewlett-Packard Ltd.
Yasuda Seimei Nishiguchi Bldg.
30-4 Tsuruya-cho, 3 Chome
Kanagawa-ku, **YOKOHAMA** 221
Tel: (045) 312-1252
C,CM,E

JORDAN

Scientific and Medical Supplies Co.
P.O. Box 1387
AMMAN
Tel: 24907, 39907
Telex: 21456 SABCO JO
C,E,M,P

KENYA

ADCOM Ltd., Inc., Kenya
P.O.Box 30070
NAIROBI
Tel: 331955
Telex: 22639
E,M

KOREA

Samsung Hewlett-Packard Co. Ltd.
Dongbang Yeoeuido Building
12-16th Floors
36-1 Yeoeuido-Dong
Youngdeungpo-Ku
SEOUL
Tel: 784-4666, 784-2666
Telex: 25166 SAMSAN K
C,CM,E,M,P

Young In Scientific Co., Ltd.
Youngwha Building
547 Shinsa Dong, Kangnam-Ku
SEOUL 135
Tel: 546-7771
Telex: K23457 GINSCO
A

Dongbang Healthcare
Products Co. Ltd.
Suite 301 Medical Supply Center
Bldg. 1-31 Dongsungdong
Jong Ro-gu, **SEOUL**
Tel: 764-1171, 741-1641
Telex: K25706 TKBKO
Cable: TKBEEPKO
M

KUWAIT

Al-Khaldiya Trading & Contracting
P.O. Box 830
SAFAT
Tel: 424910, 411726
Telex: 22481 AREEG KT
Cable: VISCOUNT
E,M,A

Gulf Computing Systems
P.O. Box 25125
SAFAT
Tel: 435969
Telex: 23648
P

Photo & Cine Equipment
P.O. Box 270
SAFAT
Tel: 2445111
Telex: 22247 MATIN KT
Cable: MATIN KUWAIT
P

W.J. Towell Computer Services
P.O. Box 5897
SAFAT
Tel: 2462640/1
Telex: 30336 TOWELL KT
C

LEBANON

Computer Information Systems S.A.L.
Chammas Building
P.O. Box 11-6274 Dora
BEIRUT
Tel: 89 40 73
Telex: 42309
C,E,M,P

LIBERIA

Unichemicals Inc.
P.O. Box 4509
MONROVIA
Tel: 224282
Telex: 4509
E

MADAGASCAR

Technique et Precision
12, rue de Nice
P.O. Box 1227
101 **ANTANANARIVO**
Tel: 22090
Telex: 22255
P

LUXEMBOURG

Hewlett-Packard Belgium S.A./N.V.
Blvd de la Woluwe, 100
Woluwedal
B-1200 **BRUSSELS**
Tel: (02) 762-32-00
Telex: 23-494 paloben bru
A,C,CM,E,M,P

MALAYSIA

Hewlett-Packard Sales (Malaysia)
Sdn. Bhd.
9th Floor
Chung Khiaw Bank Building
46, Jalan Raja Laut
50350 **KUALA LUMPUR**
Tel: 2986555
Telex: 31011 HPSM MA
A,C,E,M,P*

Protel Engineering
P.O.Box 1917
Lot 6624, Section 64
23/4 Pending Road
Kuching, **SARAWAK**
Tel: 36299
Telex: 70904 PROMAL MA
Cable: PROTELENG
A,E,M

MALTA

Philip Toledo Ltd.
Birkirkara P.O. Box 11
Notabile Rd.
MRIEHEL
Tel: 447 47, 455 66, 4915 25
Telex: Media MW 649
E,M,P

MAURITIUS

Blanche Birger Co. Ltd.
18, Jules Koenig Street
PORT LOUIS
Tel: 20828
Telex: 4296
P

MEXICO

Hewlett-Packard de Mexico,
S.A. de C.V.
Rio Nio No. 4049 Desp. 12
Fracc. Cordoba
JUAREZ
Tel: 161-3-15-62
P

Hewlett-Packard de Mexico,
S.A. de C.V.
Condominio Kadereyta
Circuito del Mezon No. 186 Desp. 6
COL. DEL PRADO - 76030 Qro.
Tel: 463-6-02-71
P

Hewlett-Packard de Mexico,
S.A. de C.V.
Monti Morelos No. 299
Fraccionamiento Loma Bonita 45060
GUADALAJARA, Jalisco
Tel: 36-31-48-00
Telex: 0684 186 ECOME
P

Microcomputadoras Hewlett-Packard,
S.A.
Monti Pelvoux 115
LOS LOMAS, Mexico, D.F.
Tel: 520-9127
P

Microcomputadoras Hewlett-Packard,
S.A. de C.V.
Monte Pelvoux No. 115
Lomas de Chapultepec, 11000
MEXICO, D.F.
Tel: 520-9127
P

Hewlett-Packard de Mexico,
S.A. de C.V.
Monte Pelvoux No. 111
Lomas de Chapultepec
11000 **MEXICO, D.F.**
Tel: 5-40-62-28, 72-66, 50-25
Telex: 17-74-507 HEWPACK MEX
A,C,CM,E,M,P

Hewlett-Packard De Mexico (Polanco)
Avenida Ejercito Nacional #579
2da y 3er piso
Colonia Granada 11560
MEXICO D.F.
Tel: 254-4433
P

Hewlett-Packard de Mexico,
S.A. de C.V.
Czda. del Valle
409 Ote. 4th Piso
Colonia del Valle
Municipio de Garza Garcia Nuevo Leon
66220 **MONTERREY,** Nuevo León
Tel: 83-78-42-40
Telex: 382410 HPMY
C

Infograficas y Sistemas del Noreste, S.A.
Rio Orinoco #171 Oriente
Despacho 2001
Colonia Del Valle
MONTERREY
Tel: 559-4415, 575-3837
Telex: 483164
A,E

Hewlett-Packard de Mexico,
S.A. de C.V.
Blvd. Independencia No. 2000 Ote.
Col. Estrella
TORREON, COAH.
Tel: 171-18-21-99
P

MOROCCO

Etablissement Hubert Dolbeau & Fils
81 rue Karatchi
B.P. 11133
CASABLANCA
Tel: 3041-82, 3068-38
Telex: 23051, 22822
E

Gerep
2, rue Agadir
Boite Postale 156
CASABLANCA 01
Tel: 272093, 272095
Telex: 23 739
P

Sema-Maroc
Dept. Seric
6, rue Lapebie
CASABLANCA
Tel: 260980
Telex: 21641
C,P

NETHERLANDS

Hewlett-Packard Nederland B.V.
Startbaan 16
NL-1187 XR **AMSTELVEEN**
P.O. Box 667
NL-1180 AR **AMSTELVEEN**
Tel: (020) 547-6911
Telex: 13 216 HEPA NL
A,C,CM,E,M,P

Hewlett-Packard Nederland B.V.
Bongerd 2
NL 2906VK **CAPELLE A/D IJSSEL**
P.O. Box 41
NL 2900AA **CAPELLE A/D IJSSEL**
Tel: (10) 51-64-44
Telex: 21261 HEPAC NL
C,E

Hewlett-Packard Nederland B.V.
Pastoor Petersstraat 134-136
NL 5612 LV **EINDHOVEN**
P.O. Box 2342
NL 5600 CH **EINDHOVEN**
Tel: (040) 326911
Telex: 51484 hepae nl
C,E,P

NEW ZEALAND

Hewlett-Packard (N.Z.) Ltd.
5 Owens Road
P.O. Box 26-189
Epsom, **AUCKLAND**
Tel: 687-159
Cable: HEWPAK Auckland
C,CM,E,P*

Hewlett-Packard (N.Z.) Ltd.
184-190 Willis Street
WELLINGTON
P.O. Box 9443
Courtenay Place, **WELLINGTON 3**
Tel: 877-199
Cable: HEWPACK Wellington
C,CM,E,P

Northrop Instruments & Systems Ltd.
369 Khyber Pass Road
P.O. Box 8602
AUCKLAND
Tel: 794-091
Telex: 60605
A,M

Northrop Instruments & Systems Ltd.
110 Mandeville St.
P.O. Box 8388
CHRISTCHURCH
Tel: 488-873
Telex: 4203
A,M

Northrop Instruments & Systems Ltd.
Sturdee House
85-87 Ghuznee Street
P.O. Box 2406
WELLINGTON
Tel: 850-091
Telex: NZ 3380
A,M

NIGERIA

Elmeco Nigeria Ltd.
46, Calcutta Crescent Apapa
P.O. Box 244and
LAGOS
E

NORTHERN IRELAND

See United Kingdom

NORWAY

Hewlett-Packard Norge A/S
Folke Bernadottes vei 50
P.O. Box 3558
N-5033 **FYLLINGSDALEN** (Bergen)
Tel: 0047/5/16 55 40
Telex: 76621 hpnas n
C,E,M

Hewlett-Packard Norge A/S
Osterndalen 16-18
P.O. Box 34
N-1345 **OESTERAAS**
Tel. 0047/2/24 60 90
Telex: 76621 hpnas n
A,C,CM,E,M,P

Hewlett-Packard Norge A/S
Boehmergt. 42
Box 2470
N-5037 **SOLHEIMSVIK**
Tel: 0047/5/29 00 90

OMAN

Khimjil Ramdas
P.O. Box 19
MUSCAT/SULTANATE OF OMAN
Tel: 795 901
Telex: 3489 BROKER MB MUSCAT
P

Suhail & Saud Bahwan
P.O.Box 169
MUSCAT/SULTANATE OF OMAN
Tel: 734 201-3
Telex: 5274 BAHWAN MB
E

Imtac LLC
P.O. Box 9196
MINA AL FAHAL/SULTANATE OF OMAN
Tel: 561 695, 5602078, 561010
Telex: 5298 Tawoos On
A,C,M

PAKISTAN

Mushko & Company Ltd.
House No. 16, Street No. 16
Sector F-6/3
ISLAMABAD
Tel: 824545
Cable: FEMUS Islamabad
A,E,P*

Mushko & Company Ltd.
Oosman Chambers
Abdullah Haroon Road
KARACHI 0302
Tel: 524131, 524132
Telex: 2894 MUSKO PK
Cable: COOPERATOR Karachi
A,E,P*

PANAMA

Electronico Balboa, S.A.
Calle Samuel Lewis, Ed. Alfa
Apartado 4929
PANAMA 5
Tel: 64-2700
Telex: 3483 ELECTRON PG
CM,E,M,P

PERU

Cia Electro Médica S.A.
Los Flamencos 145
San Isidro
Casilla 1030
LIMA 1
Tel: 41-4325, 41-3705
Telex: Pub. Booth 25306 PEC PISIDR
CM,E,M,P

SAMS S.A.
Arenida Republica de Panama 3534
San Isidro, **LIMA**
Tel: 419928/417108
Telex: 20450 PE LIBERTAD
A,C,P

PHILIPPINES

The Online Advanced Systems Corp.
2nd Floor, Electra House
115-117 Esteban Street
Legaspi Village, Makati
Metro **MANILA**
Tel: 815-38-10 (up to 16)
Telex: 63274 ONLINE PN
A,C,E,M,P

PORTUGAL

Mundinter Intercambio
Mundial de Comércio S.A.R.L.
Av. Antonio Augusto Aguiar 138
Apartado 2761
LISBON
Tel: (19) 53-21-31, 53-21-37
Telex: 16691 munter p
M

Soquimica
Av. da Liberdade, 220-2
1298 **LISBOA** Codex
Tel: 56-21-82
Telex: 13316 SABASA
A

Telectra-Empresa Técnica de
Equipmentos Eléctricos S.A.R.L.
Rua Rodrigo da Fonseca 103
P.O. Box 2531
LISBON 1
Tel: (19) 68-60-72
Telex: 12598
CM,E

C.P.C.S.I.
Rua de Costa Cabral 575
4200 **PORTO**
Tel: 499174/495173
Telex: 26054
C,P

PUERTO RICO

Hewlett-Packard Puerto Rico
101 Muñoz Rivera Av
Esu. Calle Ochoa
HATO REY, Puerto Rico 00918
Tel: (809) 754-7800
A,C,CM,M,E,P

QATAR

Computer Arabia
P.O. Box 2750
DOHA
Tel: 428555
Telex: 4806 CHPARB
P

Nasser Trading & Contracting
P.O.Box 1563
DOHA
Tel: 422170
Telex: 4439 NASSER DH
M

SAUDI ARABIA

Modern Electronics Establishment
Hewlett-Packard Division
P.O. Box 281
Thuobah
AL-KHOBAR 31952
Tel: 895-1760, 895-1764
Telex: 671 106 HPMEEK SJ
Cable: ELECTA AL-KHOBAR
C,E,M

SALES & SUPPORT OFFICES

Arranged alphabetically by country

SAUDI ARABIA (Cont'd)

Modern Electronics Establishment
Hewlett-Packard Division
P.O. Box 1228
Redec Plaza, 6th Floor
JEDDAH
Tel: 644 96 28
Telex: 4027 12 FARNAS SJ
Cable: ELECTA JEDDAH
A,C,CM,E,M,P

Modern Electronics Establishment
Hewlett-Packard Division
P.O.Box 22015
RIYADH 11495
Tel: 491-97 15, 491-63 87
Telex: 202049 MEERYD SJ
C,E,M

Abdul Ghani El Ajou Corp.
P.O. Box 78
RIYADH
Tel: 40 41 717
Telex: 200 932 EL AJOU
P

SCOTLAND

See United Kingdom

SENEGAL

Societe Hussein Ayad & Cie.
76, Avenue Georges Pompidou
B.P. 305
DAKAR
Tel: 32339
Cable: AYAD-Dakar
E

Moneger Distribution S.A.
1, Rue Parent
B.P. 148
DAKAR
Tel: 215 671
Telex: 587
P

Systeme Service Conseil (SSC)
14, Avenue du Parachois
DAKAR ETOILE
Tel: 219976
Telex: 577
C,P

SINGAPORE

Hewlett-Packard Singapore (Sales) Pte. Ltd.
#08-00 Inchcape House
450-2 Alexandra Road
Alexandra P.O. Box 58
SINGAPORE, 9115
Tel: 4731788
Telex: 34209 HPSGSO RS
Cable: HEWPACK, Singapore
A,C,E,M,P

Dynamar International Ltd.
Unit 05-11 Block 6
Kolam Ayer Industrial Estate
SINGAPORE 1334
Tel: 747-6188
Telex: 26283 RS
CM

SOUTH AFRICA

Hewlett-Packard So Africa (Pty.) Ltd.
P.O. Box 120
Howard Place **CAPE PROVINCE** 7430
Pine Park Center, Forest Drive
Pinelands
CAPE PROVINCE 7405
Tel: (021) 53 7954
Telex: 57-20006
A,C,CM,E,M,P

Hewlett-Packard So Africa (Pty.) Ltd.
2nd Floor Juniper House
92 Overport Drive
DURBAN 4067
Tel: (031) 28-4178
Telex: 6-22954
C

Hewlett-Packard So Africa (Pty.) Ltd.
6 Linton Arcade
511 Cape Road
Linton Grange
PORT ELIZABETH 6001
Tel: 041-301201
Telex: 24-2916
C

Hewlett-Packard So Africa (Pty.) Ltd.
Fountain Center
Kalkoen Str.
Monument Park Ext 2
PRETORIA 0105
Tel: (012) 45 5725
Telex: 32163
C,E

Hewlett-Packard So Africa (Pty.) Ltd.
9 Eastern Service Road
Eastgate Ext. 3
SANDTON 2144
Tel: 802-5111, 802-5125
Telex: 4-20877 SA
Cable: HEWPACK Johannesburg
A,C,CM,E,M,P

SPAIN

Hewlett-Packard Española, S.A.
Calle Entenza, 321
08029 **BARCELONA**
Tel: 3/322 24 51, 321 73 54
Telex: 52603 hpbee
A,C,E,M,P

Hewlett-Packard Española, S.A.
Calle San Vicente S/N
Edificio Albia II-7B
48001 **BILBAO**
Tel: 4/423 83 06
A,C,E,M

Hewlett-Packard Española, S.A.
Crta. de la Coruña, Km. 16, 400
Las Rozas
E-MADRID
Tel: (1) 637.00.11
Telex: 23515 HPE
C,M

Hewlett-Packard Española, S.A.
Avda. S. Francisco Javier, S/N
Planta 10. Edificio Sevilla 2
41005 **SEVILLA**
Tel: 54/64 44 54
Telex: 72933
A,C,M,P

Hewlett-Packard Española, S.A.
Isabel La Catolica, 8
46004 **VALENCIA**
Tel: (96) 351 59 44
Telex: 63435
C,P

Hewlett-Packard Española, S.A.
Av. de Zugazarte, 8
Edificio El Abra 4
Las Arenas-Guecho
VIZCAYA
Tel: (94) 464 3255, 464 2933
Telex: 33032

SWEDEN

Hewlett-Packard Sverige AB
Östra Tullgatan 3
S-20011 **MALMÖ**
Box 6132
Tel: (040) 70270
Telex: (854) 17886 (via Spånga office)
C,P

Hewlett-Packard Sverige AB
Västra Vintergatan 9
S-70344 **ÖREBRO**
Tel: (19) 10-48-80
Telex: (854) 17886 (via Spånga office)
C

Hewlett-Packard Sverige AB
Skalholtsgatan 9, Kista
Box 19
S-16393 **SPÅNGA**
Tel: (08) 750-2000
Telex: (854) 17886
Telefax: (08) 7527781
A,C,CM,E,M,P

Hewlett-Packard Sverige AB
Box 266
Topasgatan 1A
S-42123 **VÄSTRA-FRÖLUNDA** (Gothenburg)
Tel: (031) 89-10-00
Telex: (854) 17886 (via Spånga office)
A,C,CM,E,M,P

SUDAN

Mediterranean Engineering & Trading Co. Ltd.
P.O. Box 1025
KHARTOUM
Tel: 41184
Telex: 24052
C,P

SWITZERLAND

Hewlett-Packard (Schweiz) AG
Clarastrasse 12
CH-4058 **BASEL**
Tel: (61) 33-59-20
A,C,E,P

Hewlett-Packard (Schweiz) AG
7, rue du Bois-du-Lan
Case postale 365
CH-1217 **MEYRIN** 1
Tel: (0041) 22-83-11-11
Telex:27333 HPAG CH
A,C,CM,E,M,P

Hewlett-Packard (Schweiz) AG
Allmend 2
CH-8967 **WIDEN**
Tel: (0041) 57 31 21 11
Telex: 53933 hpag ch
Cable: HPAG CH
A,C,CM,E,M,P

Hewlett-Packard (Schweiz) AG
Schwamendingenstrasse 10
8050 **ZURICH**
Tel: (0041) 1 315 81 81
Telex: 823 537 HPAG CH
C,P

SYRIA

General Electronic Inc.
Nuri Basha Ahnaf Ebn Kays Street
P.O. Box 5781
DAMASCUS
Tel: 33-24-87
Telex: 411 215
Cable: ELECTROBOR DAMASCUS
E

Middle East Electronics
P.O.Box 2308
Abu Rumaneh
DAMASCUS
Tel: 33 45 92
Telex: 411 771
M

TAIWAN

Hewlett-Packard Taiwan Ltd.
THM Office
2, Huan Nan Road
CHUNG LI, Taoyuan
Tel: (034) 929-666
C

Hewlett-Packard Taiwan Ltd.
Kaohsiung Office
11/F, 456, Chung Hsiao 1st Road
KAOHSIUNG
Tel: (07) 2412318
C,E

Hewlett-Packard Taiwan Ltd.
8th Floor, Hewlett-Packard Building
337 Fu Hsing North Road
TAIPEI
Tel: (02) 712-0404
Telex: 24439 HEWPACK
Cable:HEWPACK Taipei
A,C,CM,E,M,P

ing Lih Trading Co.
6th Floor, 112, Sec. 1,
Chung Hsiao East Road
TAIPEI 100
Tel: (02) 394-8191
Telex: 22894 SANKWANG
A

THAILAND

Unimesa Co. Ltd.
30 Patpong Ave., Suriwong
BANGKOK 10500
Tel: 235-5727, 234-0991/3
Telex: 84439 Simonco TH
Cable: UNIMESA Bangkok
A,C,E,M

Bangkok Business Equipment Ltd.
5/5-6 Dejo Road
BANGKOK
Tel: 234-8670, 234-8671
Telex: 87699-BEQUIPT TH
Cable: BUSIQUIPT Bangkok
P

TOGO

Societe Africaine De Promotion
B.P. 12271
LOME
Tel: 21-62-88
Telex: 5304
P

TRINIDAD & TOBAGO

Caribbean Telecoms Ltd.
Corner McAllister Street &
Eastern Main Road, Laventille
P.O. Box 732
PORT-OF-SPAIN
Tel: 624-4213
Telex: 22561 CARTEL WG
Cable: CARTEL, PORT OF SPAIN
CM,E,M,P

Computer and Controls Ltd.
P.O. Box 51
66 Independence Square
PORT-OF-SPAIN
Tel: 623-4472
Telex: 3000 POSTLX WG, ACCT
LOOGO AGENCY 1264
A,P

Feral Assoc.
8 Fitzgerald Lane
PORT-OF-SPAIN
Tel: 62-36864, 62-39255
Telex: 22432 FERALCO
Cable: FERALCO
M

TUNISIA

Tunisie Electronique S.A.R.L.
31 Avenue de la Liberte
TUNIS
Tel: 280-144
C,E,P

Tunisie Electronique S.A.R.L.
94, Av. Jugurtha, Mutuelleville
1002 **TUNIS-BELVEDERE**
Tel: 280144
Telex: 13238
C,E,P

Corema S.A.
1 ter. Av. de Carthage
TUNIS
Tel: 253-821
Telex: 12319 CABAM TN
M

TURKEY

E.M.A
Mediha Eldem Sokak No. 41/6
Yenisehir
ANKARA
Tel: 319175
Telex: 42321 KTX TR
Cable: EMATRADE ANKARA
M

Teknim Company Ltd.
Iran Caddesi No. 7
Karaklidere
ANKARA
Tel: 275800
Telex: 42155 TKNM TR
C,E

Kurt & Kurt A.S.
Mithatpasa Caddesi No. 75
Kat 4 Kizilay
ANKARA
Tel: 318875/6/7/8
Telex: 42490 MESR TR
A

Saniva Bilgisayar Sistemleri A.S.
Buyukdere Caddesi 103/6
Gayrettepe
ISTANBUL
Tel: 1673180
Telex: 26345 SANI TR
C,P

Best Inc.
Esentepe, Gazeteciler Sitesi
Keskin Kalem
Sokak 6/3, Gayrettepe
ISTANBUL
Tel: 172 1328, 173 3344
Telex: 42490
A

UNITED ARAB EMIRATES

Emitac Ltd.
P.O. Box 1641
SHARJAH
Tel: 591181
Telex: 68136 EMITAC EM
Cable: EMITAC SHARJAH
E,C,M,P,A

Emitac Ltd.
P.O. Box 2711
ABU DHABI
Tel: 820419-20
Cable: EMITACH ABUDHABI

Emitac Ltd.
P.O. Box 8391
DUBAI,
Tel: 377591

Emitac Ltd.
P.O. Box 473
RAS AL KHAIMAH
Tel: 28133, 21270

UNITED KINGDOM

ENGLAND

Hewlett-Packard Ltd.
Miller House
The Ring, **BRACKNELL**
Berks RG12 1XN
Tel. 0344 424898
Telex. 848733
E

Hewlett-Packard Ltd.
Elstree House, Elstree Way
BOREHAMWOOD, Herts WD6 1SG
Tel: 01 207 5000
Telex 8952716
C,E

Hewlett-Packard Ltd.
Oakfield House, Oakfield Grove
Clifton **BRISTOL,** Avon BS8 2BN
Tel: 0272 736806
Telex: 444302
C,E,P

Hewlett-Packard Ltd.
9 Bridewell Place
LONDON EC4V 6BS
Tel: 01 583 6565
Telex: 298163
C,P

Hewlett-Packard Ltd.
Pontefract Road
NORMANTON, West Yorkshire WF6 1RN
Tel: 0924 895566
Telex: 557355
C,P

Hewlett-Packard Ltd.
The Quadrangle
106-118 Station Road
REDHILL, Surrey RH1 1PS
Tel: 0737 68655
Telex: 947234
C,E,P

Hewlett-Packard Ltd.
Avon House
435 Stratford Road
Shirley, **SOLIHULL,** West Midlands
B90 4BL
Tel: 021 745 8800
Telex: 339105
C,E,P

Hewlett-Packard Ltd.
Heathside Park Road
Cheadle Heath
STOCKPORT
Cheshire
SK3 ORB
Tel: 061-428-0828
Telex: 668068
A,C,E,M,P

Hewlett-Packard Ltd.
Harmon House
No. 1 George Street
UXBRIDGE, Middlesex UX8 1YN
Tel: 895 720 20
Telex: 893134/5
C,CM,E,M,P

Hewlett-Packard Ltd.
King Street Lane
Winnersh, **WOKINGHAM**
Berkshire RG11 5AR
Tel: 0734 784774
Telex: 847178
A,C,E,M,P

NORTHERN IRELAND

Hewlett-Packard (Ireland) Ltd.
Carrickfergus Industrial Centre
75 Belfast Road, Carrickfergus
CO. ANTRIM BT38 8PM
Tel: 09603 67333
C,E

Cardiac Services Company
95A Finaghy Road South
BELFAST, BT10 OBY
Tel: 0232-625566
Telex: 747626
M

SCOTLAND

Hewlett-Packard Ltd.
1/3 Springburn Place
College Milton North
EAST KILBRIDE, G74 3NU
Tel: 03552-49261
Telex: 779615
C,E

Hewlett-Packard Ltd.
SOUTH QUEENSFERRY
West Lothian, EH30 9TG
Tel: 031 331 1188
Telex: 72682
C,CM,E,M,P

UNITED STATES

Alabama

Hewlett-Packard Co.
2100 Riverchase Center
Building 100 - Suite 118
BIRMINGHAM, AL 35244
Tel: (205) 988-0547
A,C,M,P*

Hewlett-Packard Co.
420 Wynn Drive
HUNTSVILLE, AL 35805
Tel: (205) 830-2000
C,CM,E,M*

Alaska

Hewlett-Packard Co.
3601 C St., Suite 1416
ANCHORAGE, AK 99503
Tel: (907) 563-8855
C,E

Arizona

Hewlett-Packard Co.
8080 Pointe Parkway West
PHOENIX, AZ 85044
Tel: (602) 273-8000
A,C,CM,E,M,P

Hewlett-Packard Co.
3400 East Britannia Dr.
Bldg. C, Suite 124
TUCSON, AZ 85706
Tel: (602) 573-7400
C,E,M**

California

Hewlett-Packard Co.
99 South Hill Dr.
BRISBANE, CA 94005
Tel. (415) 330-2500
C

Hewlett-Packard Co.
5060 E. Clinton Avenue, Suite 102
FRESNO, CA 93727
Tel: (209) 252-9652
C,M

Hewlett-Packard Co.
1421 S. Manhattan Av.
FULLERTON, CA 92631
Tel: (714) 999-6700
C,CM,E,M

Hewlett-Packard Co.
7408 Hollister Ave. #A
GOLETA, CA 93117
Tel: (805) 685-6100
C,E

SALES & SUPPORT OFFICES
Arranged alphabetically by country

UNITED STATES (Cont'd)

Hewlett-Packard Co.
2525 Grand Avenue
LONG BEACH, CA 90815
Tel: (213) 498-1111
C

Hewlett-Packard Co.
5651 West Manchester Ave.
LOS ANGELES, CA 90045
Tel: (213) 337-8000
Telex: 910-325-6608
C,M

Hewlett-Packard Co.
3155 Porter Drive
PALO ALTO, CA 94304
Tel: (415) 857-8000
C,E

Hewlett-Packard Co.
4244 So. Market Court, Suite A
SACRAMENTO, CA 95834
Tel: (916) 929-7222
A*,C,E,M

Hewlett-Packard Co.
9606 Aero Drive
SAN DIEGO, CA 92123
Tel: (619) 279-3200
C,CM,E,M

Hewlett-Packard Co.
5725 W. Las Positas Blvd.
PLEASANTON, CA 94566
Tel: (415) 460-0282
C

Hewlett-Packard Co.
3003 Scott Boulevard
SANTA CLARA, CA 95054
Tel: (408) 988-7000
Telex: 910-338-0586
A,C,CM,E

Hewlett-Packard Co.
2150 W. Hillcrest Dr.
THOUSAND OAKS, CA 91320
(805) 373-7000
C,CM,E

Colorado

Hewlett-Packard Co.
2945 Center Green Court South
Suite A
BOULDER, CO 80301
Tel: (303) 499-6655
A,C,E

Hewlett-Packard Co.
24 Inverness Place, East
ENGLEWOOD, CO 80112
Tel: (303) 649-5000
A,C,CM,E,M

Connecticut

Hewlett-Packard Co.
500 Sylvan Av.
BRIDGEPORT, CT 06606
Tel: (203) 371-6454
C,E

Hewlett-Packard Co.
47 Barnes Industrial Road South
WALLINGFORD, CT 06492
Tel: (203) 265-7801
A,C,CM,E,M

Florida

Hewlett-Packard Co.
2901 N.W. 62nd Street
FORT LAUDERDALE, FL 33309
Tel: (305) 973-2600
C,E,M,P*

Hewlett-Packard Co.
6800 South Point Parkway
Suite 301
JACKSONVILLE, FL 32216
Tel: (904) 636-9955
C*,M**

Hewlett-Packard Co.
255 East Drive, Suite B
MELBOURNE, FL 32901
Tel: (305) 729-0704
CM,E

Hewlett-Packard Co.
6177 Lake Ellenor Drive
ORLANDO, FL 32809
Tel: (305) 859-2900
A,C,CM,E,P*

Hewlett-Packard Co.
4700 Bayou Blvd.
Building 5
PENSACOLA, FL 32503
Tel: (904) 476-8422
A,C,M

Hewlett-Packard Co.
5550 W. Idlewild, #150
TAMPA, FL 33614
Tel: (813) 884-3282
C,E,M,P

Georgia

Hewlett-Packard Co.
2000 South Park Place
ATLANTA, GA 30339
Tel: (404) 955-1500
Telex: 810-766-4890
A,C,CM,E,M,P*

Hewlett-Packard Co.
3607 Parkway Lane
Suite 300
NORCROSS, GA 30092
Tel: (404) 448-1894
C,E,P

Hawaii

Hewlett-Packard Co.
Kawaiahao Plaza, Suite 190
567 South King Street
HONOLULU, HI 96813
Tel: (808) 526-1555
A,C,E,M

Idaho

Hewlett-Packard Co.
11309 Chinden Blvd.
BOISE, ID 83707
Tel: (208) 323-2700
C

Illinois

Hewlett-Packard Co.
304 Eldorado Road
P.O. Box 1607
BLOOMINGTON, IL 61701
Tel: (309) 662-9411
A,C,E,M**

Hewlett-Packard Co.
525 W. Monroe, #1308
CHICAGO, IL 60606
Tel: (312) 930-0010
C

Hewlett-Packard Co.
1200 East Diehl Road
NAPERVILLE, IL 60566
Tel: (312) 357-8800
C

Hewlett-Packard Co.
5201 Tollview Drive
ROLLING MEADOWS, IL 60008
Tel: (312) 255-9800
Telex: 910-687-1066
A,C,CM,E,M

Indiana

Hewlett-Packard Co.
11911 N. Meridian St.
CARMEL, IN 46032
Tel: (317) 844-4100
A,C,CM,E,M

Hewlett-Packard Co.
111 E. Ludwig Road
Suite 108
FT. WAYNE, IN 46825
Tel: (219) 482-4283
C,E

Iowa

Hewlett-Packard Co.
4070 22nd Av. SW
CEDAR RAPIDS, IA 52404
Tel: (319) 390-4250
C,E,M

Hewlett-Packard Co.
4201 Corporate Dr.
WEST DES MOINES, IA 50265
Tel: (515) 224-1435
A**,C,M**

Kansas

Hewlett-Packard Co.
7804 East Funston Road, Suite 203
WICHITA, KS 67207
Tel: (316) 684-8491
C,E

Kentucky

Hewlett-Packard Co.
10300 Linn Station Road, Suite 100
LOUISVILLE, KY 40223
Tel: (502) 426-0100
A,C,M

Louisiana

Hewlett-Packard Co.
160 James Drive East
ST. ROSE, LA 70087
P.O. Box 1449
KENNER, LA 70063
Tel: (504) 467-4100
A,C,E,M,P

Maryland

Hewlett-Packard Co.
3701 Koppers Street
BALTIMORE, MD 21227
Tel: (301) 644-5800
Telex: 710-862-1943
A,C,CM,E,M

Hewlett-Packard Co.
2 Choke Cherry Road
ROCKVILLE, MD 20850
Tel: (301) 948-6370
A,C,CM,E,M

Massachusetts

Hewlett-Packard Co.
1775 Minuteman Road
ANDOVER, MA 01810
Tel: (617) 682-1500
A,C,CM,E,M,P*

Hewlett-Packard Co.
32 Hartwell Avenue
LEXINGTON, MA 02173
Tel: (617) 861-8960
C,E

Michigan

Hewlett-Packard Co.
4326 Cascade Road S.E.
GRAND RAPIDS, MI 49506
Tel: (616) 957-1970
C,M

Hewlett-Packard Co.
39550 Orchard Hill Place Drive
NOVI, MI 48050
Tel: (313) 349-9200
A,C,E,M

Hewlett-Packard Co.
1771 W. Big Beaver Road
TROY, MI 48084
Tel: (313) 643-6474
C

Minnesota

Hewlett-Packard Co.
2025 W. Larpenteur Ave.
ST. PAUL, MN 55113
Tel: (612) 644-1100
A,C,CM,E,M

Missouri

Hewlett-Packard Co.
1001 E. 101st Terrace Suite 120
KANSAS CITY, MO 64131-3368
Tel: (816) 941-0411
A,C,CM,E,M

Hewlett-Packard Co.
13001 Hollenberg Drive
BRIDGETON, MO 63044
Tel: (314) 344-5100
A,C,E,M

Nebraska

Hewlett-Packard
11626 Nicholas St.
OMAHA, NE 68154
Tel: (402) 493-0300
C,E,M

New Jersey

Hewlett-Packard Co.
120 W. Century Road
PARAMUS, NJ 07653
Tel: (201) 265-5000
A,C,CM,E,M

Hewlett-Packard Co.
20 New England Av. West
PISCATAWAY, NJ 08854
Tel: (201) 562-6100
A,C,CM,E

New Mexico

Hewlett-Packard Co.
7801 Jefferson N.E.
ALBUQUERQUE, NM 87109
Tel: (505) 823-6100
C,E,M

Hewlett-Packard Co.
1460 Trinity Dr., Suite 3
LOS ALAMOS, NM 87544
Tel: (505) 662-6700
C,E

New York

Hewlett-Packard Co.
5 Computer Drive South
ALBANY, NY 12205
Tel: (518) 458-1550
A,C,E,M

Hewlett-Packard Co.
9600 Main Street
CLARENCE, NY 14031
Tel: (716) 759-8621
C,E

Hewlett-Packard Co.
200 Cross Keys Office Park
FAIRPORT, NY 14450
Tel: (716) 223-9950
A,C,CM,E,M

Hewlett-Packard Co.
7641 Henry Clay Blvd.
LIVERPOOL, NY 13088
Tel: (315) 451-1820
A,C,CM,E,M

Hewlett-Packard Co.
No. 1 Pennsylvania Plaza
55th Floor
34th Street & 8th Avenue
MANHATTAN NY 10119
Tel: (212) 971-0800
C,M*

Hewlett-Packard Co.
15 Myers Corner Rd.
Hollowbrook Park, Suite 2D
WAPPINGER FALLS, NY 12590
Tel: (914) 298-9125
CM,E

Hewlett-Packard Co.
2975 Westchester Avenue
PURCHASE, NY 10577-2590
Tel: (914) 935-6300
C,CM,E

Hewlett-Packard Co.
3 Crossways Park West
WOODBURY, NY 11797
Tel: (516) 682-7800
A,C,CM,E,M

North Carolina

Hewlett-Packard Co.
305 Gregson Dr.
CARY, NC 27511
Tel: (919) 467-6600
C,CM,E,M,P*

Hewlett-Packard Co.
9600-H Southern Pine Blvd.
CHARLOTTE, NC 28210
Tel: (704) 527-8780
C*

Hewlett-Packard Co.
5605 Roanne Way
GREENSBORO, NC 27420
Tel: (919) 852-1800
A,C,CM,E,M,P*

Ohio

Hewlett-Packard Co.
2717 S. Arlington Road
AKRON, OH 44312
Tel: (216) 644-2270
C,E

Hewlett-Packard Co.
4501 Erskine Road
CINCINNATI, OH 45242
Tel: (513) 891-9870
C,M

Hewlett-Packard Co.
15885 Sprague Road
CLEVELAND, OH 44136
Tel: (216) 243-7300
A,C,CM,E,M

Hewlett-Packard Co.
9080 Springboro Pike
MIAMISBURG, OH 45342
Tel: (513) 433-2223
A,C,CM,E*,M

Hewlett-Packard Co.
One Maritime Plaza, 5th Floor
720 Water Street
TOLEDO, OH 43604
Tel: (419) 242-2200
C

Hewlett-Packard Co.
675 Brooksedge Blvd.
WESTERVILLE, OH 43081
Tel: (614) 891-3344
C,CM,E*

Oklahoma

Hewlett-Packard Co.
3525 N.W. 56th St.
Suite C-100
OKLAHOMA CITY, OK 73112
Tel: (405) 946-9499
C,E*,M

Hewlett-Packard Co.
3840 S. 103rd E. Ave., #100
TULSA, OK 74146
Tel: (918) 665-3300
A**,C,E,M*,P*

Oregon

Hewlett-Packard Co.
9255 S. W. Pioneer Court
WILSONVILLE, OR 97070
Tel: (503) 682-8000
A,C,E*,M

Pennsylvania

Hewlett-Packard Co.
50 Dorchester Rd.
HARRISBURG, PA 17112
Tel: (717) 657-5900
C

Hewlett-Packard Co.
111 Zeta Drive
PITTSBURGH, PA 15238
Tel: (412) 782-0400
A,C,E,M

Hewlett-Packard Co.
2750 Monroe Boulevard
VALLEY FORGE, PA 19482
Tel: (215) 666-9000
A,C,CM,E,M

South Carolina

Hewlett-Packard Co.
Brookside Park, Suite 122
1 Harbison Way
COLUMBIA, SC 29210
Tel: (803) 732-0400
C,M

Hewlett-Packard Co.
545 N. Pleasantburg Dr.
Suite 100
GREENVILLE, SC 29607
Tel: (803) 232-8002
C

Tennessee

Hewlett-Packard Co.
One Energy Centr. Suite 200
Pellissippi Pkwy.
KNOXVILLE, TN 37932
Tel: (615) 966-4747
A,C,M

Hewlett-Packard Co.
3070 Directors Row
Directors Square
MEMPHIS, TN 38131
Tel: (901) 346-8370
A,C,M

Hewlett-Packard Co.
220 Great Circle Road, Suite 116
NASHVILLE, TN 37228
Tel: (615) 255-1271
A,C,E,M,P

Texas

Hewlett-Packard Co.
1826-P Kramer Lane
AUSTIN, TX 78758
Tel: (512) 835-6771
C,E,P*

Hewlett-Packard Co.
5700 Cromo Dr
EL PASO, TX 79912
Tel: (915) 833-4400
C,E*,M**

Hewlett-Packard Co.
3952 Sandshell Drive
FORT WORTH, TX 76137
Tel: (817) 232-9500
C

Hewlett-Packard Co.
10535 Harwin Drive
HOUSTON, TX 77036
Tel: (713) 776-6400
A,C,E,M,P*

Hewlett-Packard Co.
3301 Royal Lane
IRVING, TX 75063
Tel: (214) 869-3377
C,E

Hewlett-Packard Co.
109 E. Toronto, Suite 100
McALLEN, TX 78503
Tel: (512) 630-3030
C

Hewlett-Packard Co.
930 E. Campbell Rd.
RICHARDSON, TX 75081
Tel: (214) 231-6101
A,C,CM,E,M,P*

Hewlett-Packard Co.
1020 Central Parkway South
SAN ANTONIO, TX 78232
Tel: (512) 494-9336
A,C,E,M,P*

Utah

Hewlett-Packard Co.
3530 W. 2100 South St.
SALT LAKE CITY, UT 84119
Tel: (801) 974-1700
A,C,E,M

Virginia

Hewlett-Packard Co.
840 Greenbrier Circle
Suite 101
CHESAPEAKE, VA 23320
Tel: (804) 424-7105
C,E,M

Hewlett-Packard Co.
4305 Cox Road
GLEN ALLEN, VA 23060
Tel: (804) 747-7750
A,C,E,M,P*

Hewlett-Packard Co.
Tanglewood West Bldg.
Suite 240
3959 Electric Road
ROANOKE, VA 24018
Tel: (703) 774-3444
C,E,P

Washington

Hewlett-Packard Co.
15815 S.E. 37th Street
BELLEVUE, WA 98006
Tel: (206) 643-4000
A,C,CM,E,M

Hewlett-Packard Co.
North 708 Argonne Road
SPOKANE, WA 99212-2793
Tel: (509) 922-7000
C

West Virginia

Hewlett-Packard Co.
501 56th Street
CHARLESTON, WV 25304
Tel: (304) 925-0492
A,C,M

Wisconsin

Hewlett-Packard Co.
275 N. Corporate Dr.
BROOKFIELD, WI 53005
Tel: (414) 794-8800
A,C,E*,M

URUGUAY

Pablo Ferrando S.A.C. e I.
Avenida Italia 2877
Casilla de Correo 370
MONTEVIDEO
Tel: 80-3805
Telex: Public Booth 901
A,CM,E,M

SALES & SUPPORT OFFICES
Arranged alphabetically by country

URUGUAY (Cont'd)
Olympia de Uruguay S.A.
Maquines de Oficina
Avda. del Libertador 1997
Casilla de Correos 6644
MONTEVIDEO
Tel: 91-1809, 98-3807
Telex: 6342 OROU UY
P

VENEZUELA
Hewlett-Packard de Venezuela C.A.
3A Transversal Los Ruices Norte
Edificio Segre 2 & 3
Apartado 50933
CARACAS 1050
Tel: (582) 239-4133
Telex: 251046 HEWPACK
A,C,CM,E,M,P

Hewlett-Packard de Venezuela, C.A.
Centro Ciudad Comercial Tamanaco
Nivel C-2 (Nueva Etapa)
Local 53H05
Chuao, **CARACAS**
Tel: 928291
P

Albis Venezolana S.R.L.
Av. Las Marias, Ota. Alix,
El Pedregal
Apartado 81025
CARACAS 1080A
Tel: 747984, 742146
Telex: 24009 ALBIS VC
A

Tecnologica Medica del Caribe, C.A.
Multicentro Empresarial del Este
Ave. Libertador
Edif. Libertador
Nucleo "C" - Oficina 51-52
CARACAS
Tel: 339867/333780
M

Hewlett-Packard de Venezuela C.A.
Residencias Tia Betty Local 1
Avenida 3 y con Calle 75
MARACAIBO, Estado Zulia
Apartado 2646
Tel: (5861) 80304
Telex: 62464 HPMAR
C,E*

Hewlett-Packard de Venezuela C.A.
Urb. Lomas de Este
Torre Trebol — Piso 11
VALENCIA, Estado Carabobo
Apartado 3347
Tel: (5841) 222992
C,P

YUGOSLAVIA
Do Hermes
General Zdanova 4
YU-11000 **BEOGRAD**
Tel: (011) 342 641
Telex: 11433
A,C,E,M,P

Do Hermes
Celovska 73
YU-61000 **LJUBLJANA**
Tel: (061) 553 170
Telex: 31583
A,C,E,M,P

Elektrotehna
Titova 51
YU-61000 **LJUBLJANA**
CM

Do Hermes
Kralja Tomislava 1
YU-71000 **SARAJEVO**
Tel: (071) 35 859
Telex: 41634
C**,P

ZAIRE
Computer & Industrial Engineering
25, Avenue de la Justice
B.P. 12797
KINSHASA, Gombe
Tel: 32063
Telex: 21552
C,P

ZAMBIA
R.J. Tilbury (Zambia) Ltd.
P.O. Box 32792
LUSAKA
Tel: 215590
Telex: 40128
E

ZIMBABWE
Field Technical Sales (Private) Limited
45, Kelvin Road North
P.O. Box 3458
SALISBURY
Tel: 705 231
Telex: 4-122 RH
E,P

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Hewlett-Packard Company
Colorado Telecommunications Division
5070 Centennial Blvd
P.O. Box 7050
Colorado Springs, Colorado 80933 U.S.A.

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